

Stafford Borough Council

Strategic Flood Risk Assessment for
Local Development Framework
Level 1
Volume 1 – FINAL
January 2008

Halcrow Group Limited



Stafford Borough Council
Strategic Flood Risk Assessment for
Local Development Framework
Level 1 - FINAL
Volume 1

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Executive Summary

In August 2007 a group comprising the District and Borough Councils of Tamworth, Lichfield, Stafford and Staffordshire Moorlands commissioned Halcrow to produce a Level 1 Strategic Flood Risk Assessment (SFRA) in accordance with Planning Policy Statement 25 (PPS 25). The purpose of this SFRA is to assess and map all forms of flood risk from groundwater, surface water, sewer and river sources, taking into account future climate change predictions, and use this as an evidence base to locate future development primarily in low flood risk areas. The outputs from the SFRA will help Stafford Borough Council to prepare sustainable policies for the long-term management of flood risk and improve existing emergency planning procedures.

In accordance with the recently published document “Development and Flood Risk, a Practice Guide Companion to PPS 25” (February 2007), a Level 1 SFRA has been carried out and is contained herein. The study takes full account of the effect of climate change predictions as set out in PPS 25. The assessment also complies with the content of the accepted proposal dated June 2007. The SFRA should be regarded as a ‘living’ document and reviewed on a regular basis in light of new information as it becomes available.

In accordance with PPS25, areas of ‘low’, ‘medium’ and ‘high’ risk have been mapped using data collected from the Environment Agency, Stafford Borough Council, Severn Trent Water, the Highways Agency and British Waterways. This has included information on flooding from rivers, surface water (land drainage), groundwater, artificial water bodies and sewers. This provides the basis for the Sequential Test to be applied.

The Council will need to apply the Sequential Test to all sites within the ‘high’ and ‘medium’ risk flood zones to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed. If there is an area of overlap between the site boundary and area at risk of flooding, this should be utilised as an opportunity to reduce flood risk within the site, by using waterside areas for recreation, amenity and environmental purposes.

Where the need to apply the Exception Test is identified, if the Council considers that there are an insufficient number of suitable sites for development, the scope of the SFRA could be widened to a Level 2 assessment. It is recommended that this is undertaken by a suitably qualified technical expert or engineer.

This SFRA has been reviewed and approved by the Environment Agency, and a letter confirming acceptance of the SFRA can be found in Appendix A.

1 Introduction

1.1 Terms of Reference

In August 2007 a group comprising the District and Borough Councils of Tamworth, Lichfield, Stafford and Staffordshire Moorlands commissioned Halcrow to produce a Level 1 SFRA in accordance with Planning Policy Statement 25 (PPS 25). This report presents the findings of the SFRA, for Stafford Borough.

1.2 Project Aims

The aims of PPS 25 planning policy on development and flood risk are to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is necessary in such areas, exceptionally, the policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall. 'Safe' in the context of this study means that dry pedestrian access to and from the development is possible without passing through the 1 in 100 year plus climate change floodplain, and emergency vehicular access is possible during times of flood. It also means that the development includes flood resistance and resilience measures to ensure it is safe.

The aim of this SFRA therefore is to map all forms of flood risk and use this as an evidence base to locate new development primarily in low flood risk areas (Zone 1). Where development cannot be located in Flood Zone 1 the planning authority will need to apply the Sequential Test to land use allocations and, where necessary, the Exception Test (Level 2 SFRA). In addition, it allows a planning authority to:

- Prepare appropriate policies for the management of flood risk
- Inform the Sustainability Appraisal (SA) so that flood risk is taken account of, when considering options and in the preparation of strategic land use policies
- Identify the level of detail required for site-specific Flood Risk Assessments (FRAs)
- Determine the acceptability of flood risk in relation to emergency planning capability

The SFRA will inform the site selection process for future development sites and provide recommendations for policies to deal with non-allocated sites. The SFRA will feed into the Local Authority's SA of the Local Development Documents (LDDs) and will enable informed decisions to be made relating to land use and development allocation within the respective Development Plan Documents (DPDs).

1.3 Project Objectives

Halcrow has carried out this project in accordance with the Project Brief, dated June 2007, though the methodology and deliverables have been aligned to the document "Development and Flood Risk: A Practice Guide Companion to PPS 25". The SFRA has also followed advice from the Environment Agency.

For this study, a Level 1 SFRA approach has been agreed with the Council and the Environment Agency. A Level 1 SFRA is defined in the Practice Guide Companion to PPS25, as a desk-based

study using existing information to allow application of the Sequential Test on the basis of Table D1 of PPS25 and to identify whether application of the Exception Test is likely to be necessary.

The best available data within the study timescale has been collected for use in this study; however it is important to recognise that the SFRA is a 'living' document. As new information becomes available (such as improved river models) updates will be made to the Flood Zone maps and this should be reflected in the SFRA document, to ensure that the best information is used to guide the site selection process for future developments.

1.4 Project Deliverables

The project outputs for Level 1 SFRA have been adopted for this study. The deliverables of this assessment are as follows:

- A technical report
- A summary document
- A series of maps

Following the advice from Section 2.34 of the Practice Guide Companion to PPS 25, the key project outputs are as follows:

- 1) Plans showing the administrative boundaries of the study area, watercourse centreline, modelled watercourses, canals, defences, Areas Benefiting from Defences (ABDs) Internal Drainage Board (IDB) areas and culverted watercourse sections (Volume 2, Tile A1)
- 2) Strategic flood risk maps showing flooding from all sources, including fluvial flood zones (including the functional floodplain where possible), and areas at risk of flooding from sources other than rivers (Volume 2, Tiles B1-B6)
- 3) An assessment of the implications of climate change for flood risk in the study area over an appropriate time period (Volume 2, Tile C1)
- 4) The location of any flood risk management measures, including both infrastructure (Volume 2, Tile A1) and the coverage of flood warning systems (Volume 2, Tile F1)
- 5) Guidance on the application of the Sequential Test (see Chapter 8)
- 6) Guidance on the preparation of FRAs for development sites (see Chapter 9).
- 7) Guidance on the likely applicability of different Sustainable Drainage Systems (SUDS) techniques for managing surface water run-off at key development sites (see Chapter 10)

1.5 Outcomes of the SFRA Process

A Level 1 SFRA provides sufficient data and information to enable a planning authority to apply the Sequential Test to land use allocations and can therefore identify, where necessary, the Exception Test needs to be applied (see sections 1.5.1 and 1.5.2 respectively).

PPS25 also indicates that SAs should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development - England) Regulations 2004, an SA is required for all LDFs.

The purpose is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The Regulations stipulate that SAs for LDFs should meet the requirements of the SEA Directive. A SFRA is used as a tool by a planning authority for the production of development briefs, setting constraints, identifying locations of emergency planning measures and requirements for FRAs.

It is important to reiterate that PPS25 is not applied in isolation as part of the planning process. The formulation of Council policy and the allocation of land for future development must also meet the requirements of other planning policy. Clearly a careful balance must be sought in these instances, and the SFRA aims to assist in this process through the provision of a clear and robust evidence base upon which informed decisions can be made.

1.5.1 The Sequential Test

A planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed. Appendix B shows the Sequential Test process as advocated in PPS25.

Preference should be given to locating new development in Flood Zone 1, Low Probability (see section 3.3.1). If there is no reasonably available site in Flood Zone 1, the flood vulnerability (see table below) of the proposed development can be taken into account in locating development in Flood Zone 2 (Medium Probability) and then Flood Zone 3 (High Probability).

Within each Flood Zone new development should be directed to sites with lower flood risk (towards the adjacent zone of lower probability of flooding) from all sources as indicated by the SFRA.

Flood Risk Vulnerability and Flood Zone ‘Compatibility’ (Table D3 of PPS 25)

Flood Risk Vulnerability classification (see Table D2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone (see Table D.1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	x	Exception Test required	✓
	Zone 3b ‘Functional Floodplain’	Exception Test required	✓	x	x	x

Key:

✓ Development is appropriate

x Development should not be permitted

1.5.2 The Exception Test

If, following application of the Sequential Test, it is not possible, or consistent with wider sustainability objectives, for the development to be located in zones of lower probability of flooding, the Exception Test can be applied. This test provides a method of managing flood risk while still allowing necessary development to occur.

The Exception Test is only appropriate for use when there are large areas in Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is necessary for wider sustainable development reasons (the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during floods). It may also be appropriate to use it where restrictive national designations such as landscape, heritage and nature conservation designations, e.g. Areas of Outstanding Natural Beauty (AONBs), Sites of Special Scientific Interest (SSSIs) and World Heritage Sites (WHS), prevent the availability of unconstrained sites in lower risk areas.

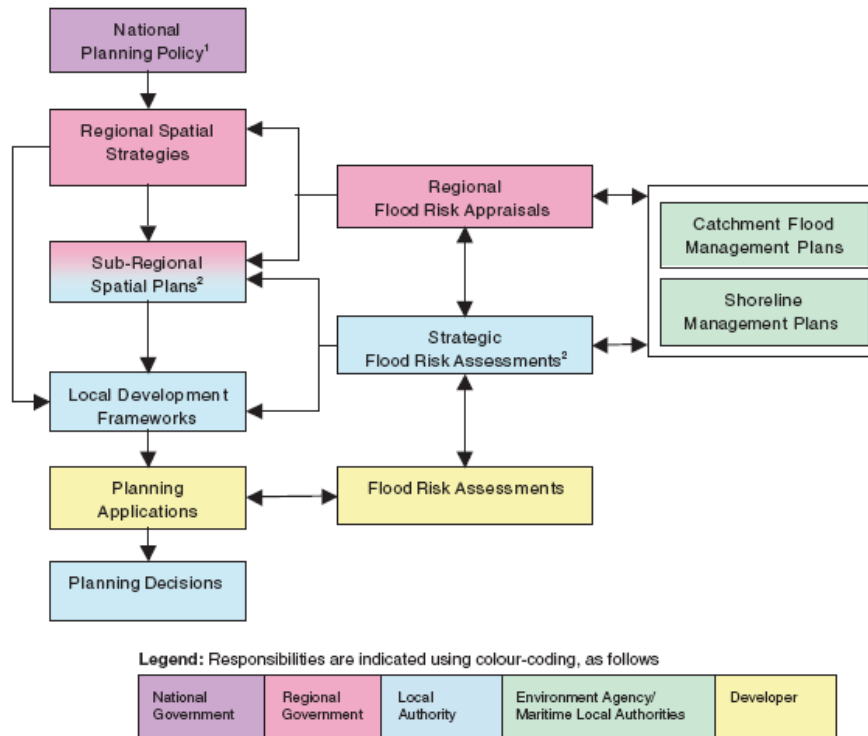
For the Exception Test to be passed:

- a) It must be demonstrated that the development provides wider sustainability benefits to the community which outweigh flood risk, informed by a SFRA where one has been prepared. If the Development Plan Document has reached the 'submission' stage (see Figure 4 of PPS12: Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;
- b) The development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and,
- c) A flood risk assessment must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

It is possible that the Council will need to apply the Exception Test if sites fall within Flood Zone 2 and 3, although it is not possible to fully determine this until the Sequential Test process has been undertaken.

1.6 SFRA Context

The figure overleaf, taken from the PPS 25 Practice Guide, illustrates the responsibilities for the production of key documents required to effectively manage flood risk through each stage of the spatial planning process, and, importantly, shows the link between other strategic documents.



Notes

- 1 Including Planning Policy Statement 25 'Development and Flood Risk' and the other flooding-related national planning policy listed in Appendix B of this Practice Guide.
- 2 SFRAs may cover more than one local planning authority region, and the adoption of a catchment-based approach by a number of LPAs working in partnership could be highly beneficial.
- 3 This diagram has been developed from the original within the Defra/EA 2005 report FD2320.

1.7 The Study Area

Stafford Borough Council covers an area of approximately 600km² and includes the main towns of Stafford and Stone. The Borough borders with Staffordshire Moorlands, Newcastle-under-Lyme, East Staffordshire, North Shropshire, Telford and Wrekin, South Staffordshire and Cannock Chase. The town of Stafford acts not only as the administrative centre of the Borough but also Staffordshire County as a whole. The 2001 census puts the population of the Borough at 120,653, with Stafford town itself home to a population of around 60,049.

Stafford is a thriving Market Town, steeped in heritage from its long history of shoe making to its association with the 'potteries'. The old businesses have largely gone now but new factories and warehouses have taken their place. The original settlement was on an island in the middle of the marshes of the River Sow, a tributary of the River Trent. There is still a large area of marshland just north of the town, which in 1947, 2000 and 2007 saw floods.

The rest of the Borough is essentially rural and forests and woodlands contribute to much of the attractiveness of the countryside. Agriculture is also an important industry and there are extensive areas of high quality land. The proximity to the nearby West Midlands conurbation and excellent road and rail links means the area provides an attractive settlement for commuters.

1.7.1 Main Rivers and Hydrology

Having risen in the Staffordshire Moorlands, the River Trent flows south through Stoke-on-Trent where it becomes designated Main River, then into Stafford Borough in the north. It flows through Stone, dissecting the Borough and exiting just north of Rugeley in Cannock Chase District. The Trent and Mersey canal runs adjacent to the River Trent for its entire journey through the Borough. The floodplain of the Trent is relatively wide through the Borough, but mostly undeveloped. Stone in particular is dissected by the River Trent floodplain, which is largely undeveloped. The catchment area of the River Trent at Stone is some 230km². A designated Main River called Scotch Brook enters the River Trent on the left bank as it flows through Stone. Further downstream, Aston Lodge Brook enters the Trent on the left bank. Aston Lodge also has a designated main River tributary called Aston Chase Brook, which flows through the south-eastern side of Stone.

The main tributary of the Trent within the Borough boundary is the River Sow. The Sow rises at Fair Oak and flows through Cop Mere and past Eccleshall where it becomes designated Main River, before flowing through Stafford and on to join the River Trent at Shuborough, where it commands a catchment area of 589km². This includes the catchment area of the River Penk (336km²) whose catchment area lies mostly south of the border in Cannock Chase District Council, but meets the Sow in east Stafford. Just upstream of this confluence, the River Sow is met by Sandyford Brook and then Kingston Brook, both on the left bank. Both these designated Main Rivers flow southwards through the northern part of Stafford.

Just downstream of Eccleshall the River Sow is met by Meece Brook on the left bank, which enters the Borough in the north-west and is designated Main River throughout. Meece Brook has a designated Main River left bank tributary called Yarnfield Brook, which rises just north of Yarnfield itself.

Doley Brook is located in the south-west of the Borough. It begins just north-west of Gnosall and flows in a south-easterly direction past Church Eaton and towards Mitton. The Brook at Mitton has a catchment area of 46km². South of the Borough, the Brook continues to join the River Penk at Penkridge. Just south of Doley Brook, Motty Meadows Brook and Marston Brook, both designated Main River, briefly enter the Borough on the southern boundary. Similarly, the River Meese and Lonco Brook briefly border the Borough on the south-western side, around Forton. Here, a number of brooks drain into Aqualate Mere, and the discharge from the Mere forms the headwaters of the River Meese. The watercourse is then joined by Lonco Brook, which also forms 3km of the Borough boundary. Both watercourses drain a predominantly rural landscape made up of farmland and small hamlets.

The Sow and Penk IDB operates within the Stafford Borough, and extends firstly from the River Penk immediately downstream of the A5 (SJ 8957 1075) and secondly from Whiston Brook (SJ 8956 1467) to the northern extent of the Borough. The River Penk itself is the responsibility of the Environment Agency, however, the Sow and Penk IDB is responsible for a number of minor watercourses and ditches within the Borough. The Sow and Penk IDB area is shown Volume 2, Tile A1.

1.7.2 Geology and Topography

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 extent of overland flow and therefore the amount of run-off reaching the watercourse. Steep slopes or clay rich (low permeability) soils will promote rapid surface runoff, whereas more permeable rock such as limestone and sandstone may result in a more subdued response.

The geology of Stafford Borough (Volume 2, Tiles D1 (solid) and D2 (drift)) consists predominantly of sedimentary rocks and is represented by three major geological periods. The oldest rocks are from the Carboniferous period, followed by rocks from the Permian and finally the younger Triassic rocks. The Carboniferous rock sequences make up approximately 82% of the geology in the Borough, with the River Sow catchment draining a predominantly Carboniferous landscape. The Sow also drains the escarpment of Cannock Chase (to the south-east of the Borough) which is highly permeable in nature. This, coupled with the moderately permeable Carboniferous landscape of the Sow catchment contributes to a slower runoff response to rainfall. The remainder of the underlying geology within the Borough consists of Mercia Mudstones, argillaceous clay-like rocks, sandstones and conglomerates. The Mercia Mudstones have a high clay content and are less permeable in comparison to the Carboniferous landscape of the Sow catchment.

Drift deposits of Till are found at the south-western and eastern extents of the Borough. Till is sediment that is deposited by glaciers and made up of clay, detritus that is indicative of the underlying argillaceous clay-rich rocks. Alluvium and river terrace deposits of clay, silt and sand are also found within the Borough along the courses of the Meece Brook, River Sow and River Trent.

The heavy clay soils form an essentially pastoral landscape across most of the Borough with undulating hills. Elevations across the Borough lie mainly below 150m where and many tributaries drain this landscape towards the River Trent.

2 Planning Context

2.1 Introduction

This section provides an overview of the planning policy framework relevant to Stafford Borough Council.

This report conforms with National and Regional Planning Policy. Information contained in the SFRA will provide evidence to facilitate the preparation of robust policies for flood risk management. The SFRA should be used to inform the SA of LDDs and will enable informed decisions to be made relating to land use and development allocation within the respective Development Plan Documents (DPDs).

The success of the SFRA is heavily dependent upon the Council's ability to implement the recommendations put forward for future sustainable flood risk management. It is ultimately the responsibility of the Council to establish robust policies that will ensure future sustainability with respect to flood risk.

2.2 Planning Policy Framework

The UK planning system has a comprehensive hierarchy of policies and plans, beginning with national guidance which provides a broad framework for regional plans through to development plans at the local level. Development plans are intended to provide clear guidance for prospective developers. They are prepared following public and stakeholder involvement and are intended to reconcile conflicts between the need for development and the need to protect the wider built and natural environment.

The Government is currently implementing reforms to the planning system with Planning Policy Statements (PPS) replacing Planning Policy Guidance (PPG), Regional Spatial Strategies (RSS) replacing Regional Planning Guidance (RPG) and Local Development Frameworks (LDF) replacing Structure and Local Plans and Unitary Development Plans.

The following paragraphs provide an overview of the relevant policy documents and a brief explanation of their significance for the SFRA.

2.3 National Planning Policy

2.3.1 PPS1: Creating Sustainable Communities (2005)

PPS1 sets out the Government's objectives for the planning system. It confirms that good planning should deliver the right development in the right place and time, and protect the environment. It identifies sustainable development as the core principle underpinning planning and requires that development plans ensure it is pursued in an integrated manner.

2.3.2 PPS3: Housing (2006)

PPS3 has been developed in response to recommendations in the Barker Review of Housing Supply (March 2004). Its principal aim is to underpin the necessary step change in housing delivery, improving the supply and affordability of housing in all communities including rural areas.

PPS3 states that the Government's key housing policy goal is to ensure that everyone has the opportunity of living in a decent home, which they can afford, in a community where they want to live. The specific outcomes that the planning system should deliver are:

- Well designed, high quality housing that is built to a high standard
- A mix of market and affordable housing for all households in all areas
- A sufficient quantity of housing, taking into account need and demand and seeking to improve choice
- Housing developments in suitable locations offering a good range of community facilities and with good access to jobs, key services and infrastructure
- A flexible, responsive supply of land; which is used efficiently and effectively, including the use of previously developed land

Housing policies should help to deliver sustainable development objectives, in particular seeking to minimise environmental impact taking account of climate change and flood risk, and take into account market information, in particular housing need and demand.

2.3.3 PPS9: Biodiversity and Geological Conservation (2005)

PPS9 sets out policies on protection of biodiversity and geological conservation through the planning system. The broad aim is that development should have minimal impacts on biodiversity and geological conservation interests and enhance them where possible. Appropriate weight should be attached to the need to protect international and national designated sites.

2.3.4 PPG15: Planning and the Historic Environment (1994)

PPG15 sets out policies on the protection of the historic environment and recognises that planning plays an important role in preserving built and natural heritage.

2.3.5 PPG17: Planning for Open Space and Recreation (2002)

PPG17 recognises the importance that public open spaces, green areas and recreational rights of way can play in supporting regeneration and contributing to local quality of life.

2.3.6 PPS25: Development and Flood Risk" (2006)

PPS25 sets out a plan led approach to flood risk. It confirms that all forms of flooding and their impact on the natural and built environment are material planning considerations. It clarifies the sequential test, a process that matches types of development to degrees of flood risk and strengthens the requirement to include flood risk assessments at all levels of the planning process. Regional planning bodies and local planning authorities (LPA) should, inter alia, reduce flood risk by safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water and flood defences.


Communities
and Local Government
Planning shapes the places where people live and work and the country we live in. It plays a key role in supporting the Government's wider economic, social and environmental objectives and for sustainable communities.



2.3.7 Town and Country Planning Amendments

Amendments to the Town and Country Planning (General Development Procedure) Order 1995 came into force on 1 October 2006 introducing further requirements for LPA to consult the Environment Agency before determining applications for development in flood risk areas.

The Town and Country Planning (Flooding) (England) Direction 2007 was published in December 2006. To safeguard against inappropriate development in flood risk areas, it introduces a requirement for LPA to notify the Secretary of State of any application for major development (e.g. 10 or more dwellings) in a flood risk area which it proposes to approve against Environment Agency advice. The Direction came into force on 1 January 2007.

2.4 Regional Planning Policy

Regional planning policies provide the overarching framework for the preparation of the LDF. Regional Planning Guidance for the West Midlands (RPG11) was published in June 2004 but under the Planning and Compulsory Purchase Act 2004, RPG11 was automatically replaced by a new Regional Spatial Strategy for the West Midlands. The purpose of the West Midlands Regional Spatial Strategy (WMRSS) is to provide a long term land-use and transport planning framework for the West Midlands region. The WMRSS framework guides the preparation of local authority development plans and local transport plans. It determines (amongst other things) the scale and distribution of housing and economic development for each District or Borough within the region, investment priorities for transport and sets out policies for enhancing the environment. The WMRSS has been prepared by the West Midlands Regional Assembly has been guided by the national policy framework provided by Planning Policy Guidance, particularly PPG11, and other key policy documents and plans including the National Sustainable Development Strategy.

The WMRSS was published in June 2004. In approving the document the Secretary of State identified a number of issues where further work was required. The revision is being carried out in three stages.

The WMRSS for the West Midlands identifies the 'North Black Country' as an Urban Regeneration Zone, identified by the Regional Economic Strategy to provide a focus for action in areas of need, and provide substantial opportunities for change. The study area will also be affected by the requirement for a provision to be made for substantial new development to serve each District.

The WMRSS also states that more rural areas of the West Midlands will be regenerated, through the improvement of choice in housing; diversification of the rural economy; better transport links both within rural areas and between urban rural areas; improving health, education, skills training, social, shopping, community facilities and other services, the sustainable use of environmental assets, and the prudent use of natural resources. The "Development and Flood Risk" section of the WMRSS identifies the following policies in relation to Flood Risk Management:

"8.42 The implications of climate change for the severity of floods is uncertain but the most realistic approach is to accept that flooding is an inevitable process. PPG25 [now PPS25] Development and Flood Risk sets out detailed guidance on how flood risk should be considered at all stages of the planning and development process, including a sequential approach to locating development. Local authorities should also consider local Environment Agency plans, Catchment Flood Management Plans and indicative floodplains (Quality of the Environment – Assets Diagram).

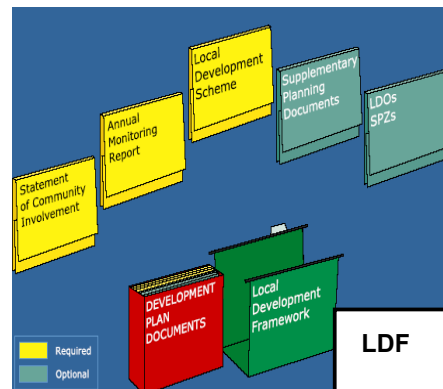
8.43 For the review of this RPG the RPB with the Environment Agency and other partners should identify where flooding issues are likely to be of Regional significance, assess their implications for the distribution of development and where appropriate, set out appropriate policies and measures to address them. This could include defining areas where sustainable drainage systems would best contribute to reducing flood risk, and improving water quality where the need to improve the performance of the floodplain, attenuate flows and provide local treatment of polluted run-off is greatest. However it should be borne in mind that sustainable drainage systems are unlikely to provide the complete answer to problems associated with large-scale river flooding episodes; in the longer term they can help attenuate flows and reduce the risk of flooding in urban areas downstream.

8.44 When considering the possible risks, implications and steps needed to prevent general flooding affecting new development, the potential for sewer flooding should also be considered by developers and planning authorities. Large new developments may require some new or updated infrastructure in the existing sewer network and treatment works in order to cope with the additional load. Sustainable drainage systems can, in the correct conditions, help alleviate sewer flooding problems by preventing surface water from entering the sewerage system.”

2.5 Local Planning Policy

2.5.1 Local Development Framework

The Stafford Borough Local Plan (2001) was adopted on 18th October 1998. The plan contains policies directing development proposals and promoting appropriate land-use. The Local Plan, as part of the Planning and Compulsory Purchase Act 2004, was saved in its entirety until 27th September 2007. Following this, The Secretary of State has now made a decision on the policies that should be saved beyond this date. These can be found on the Council's website (www.staffordbc.gov.uk).



In 2004 central government imposed a number of changes to the planning system in England. In the main, the changes are intended to speed up the overall planning process to make it more transparent. Some of the changes made impact upon the way new planning policies are created and updated. In particular, it will mean that the LPA will gradually depart from the Local Plan and create new planning policies within the new planning system, known as the LDF. Until the LDF documents are adopted, the Local Plan remains the primary document for assessing planning applications in the Borough. All saved policies will remain in force until such time as they are replaced by new policies in the LDF.

The Local Development Scheme (LDS) sets out the work programme for preparing the Stafford Borough LDF. The Council has prepared a Revised LDS (2007) that has been agreed by Government Office West Midlands and has now been approved by the Council's Cabinet in September 2007. The 2007 LDS will contain a Core Strategy DPD, Development Management DPD and Allocations and Site Specific Policy DPD

3 Study Methodology

3.1 Level 1 SFRA Methodology

A Level 1 SFRA is defined in the Practice Guide Companion as a desk-based study using existing information to allow application of the Sequential Test and to identify where the Exception Test is likely to be necessary. The main tasks undertaken during the study were as follows:

a) Establishing relationships and understanding the planning context:

An Inception meeting was held to build relationships between the project team, the Councils and the Environment Agency. This allowed the partnering approach to form, and allow the free exchange of available information. Discussions were held on the status of the Council's Local Development Frameworks and planning pressures to gain a clear picture of the challenges faced by the planning teams, and the various opportunities and constraints guiding the site allocation process. The study area was also discussed in detail, giving an overview of local features and flooding experienced from all sources.

b) Gathering data and analysing it for suitability:

A quality review of flood risk information was carried out by an experienced core team, who reviewed the collated data, assessed its significance and quality and advised on which data would be needed to drive the SFRA. The main approach adopted to the SFRA was to build on previous studies and existing information, supplied during the data collection phase.

c) Producing strategic flood risk maps, GIS deliverables and a technical report

A series of GIS maps were produced using the data gathered in the early phases of the study. The main mapping output is the strategic flood risk maps the entire study area, which shows Flood Zones 1, 2 and 3 and flooding from all other sources, and should be used to carry out the sequential test. Other maps include study area maps showing canals and fluvial features, climate change maps showing the impacts of climate change on flood probability, geological maps, historic flood outline maps, and maps showing flood watch and warning areas. Hardcopy maps are provided in Volume 2 of the SFRA report, while GIS layers can be found in the CD at the front of this report.

d) Providing suitable guidance

Sections have been written in the report providing guidance on policy considerations, the application of the Sequential Test, guidance for the preparation of FRAs and guidance for the application of SUDS in the study area. A planning workshop will also provide further guidance on the application of the Sequential Test. This will establish the principles of Sequential Test, provide mock Sequential Testing scenarios and help to develop broad policy recommendations.

3.2 Need for a Level 2 SFRA

Where the need to apply the Exception Test is identified, due to there being an insufficient number of suitably available sites for development within zones of lower flood risk or due to possible increases in flood risk arising from climate change, the scope of the SFRA may need to be widened to a Level 2 assessment.

This increased scope involves a more detailed review of flood hazard (flood probability, flood depth, flood velocity, rate of onset of flooding) taking into account the presence of flood risk management measures such as flood defences. This could include 2D modelling and breach/overlapping analysis for certain locations.

Level 2 SFRA outputs include:

- An appraisal of the condition of flood defence infrastructure and likely future policy
- An appraisal of the probability and consequence of breach or overtopping of flood defence infrastructure
- Maps showing distribution of flood risk across zones
- Guidance on appropriate policies for making sites which satisfy parts a) and b) of the Exception Test safe; and the requirements for satisfying part c) of the Exception Test
- Guidance on the preparation of FRAs for sites with varying flood risk across the Flood Zone

In general, the Level 2 SFRA should aim to provide clear guidance on appropriate risk management measures for adoption on sites within Flood Zone 3, which are protected by existing defences. This should minimise the extent to which individual developers need to undertake separate studies on the same problem. The scope of a Level 2 SFRA cannot be fully determined until the Sequential Test has been undertaken by each Council on all possible site allocations.

3.3 Technical Background

It is useful to gain a good understanding of Flood Zones and the approaches taken to satisfy the Level 1 SFRA requirements, using existing data.

3.3.1 Flood Zones

Flood Zones show the areas potentially at risk of flooding from rivers or the sea, ignoring the presence of defences (although areas benefiting from formal defences are identified).

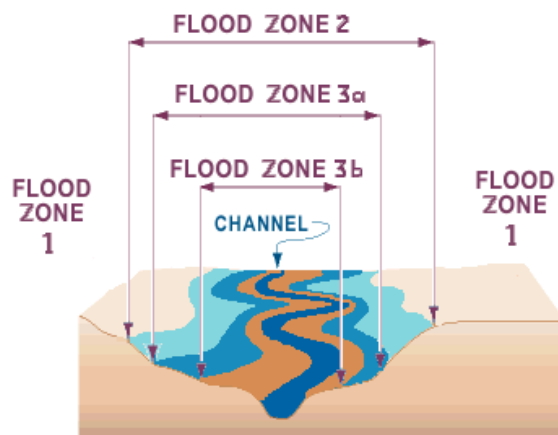
PPS 25 defines the flood zones as follows:

Zone 1: Low Probability

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).

Zone 2: Medium Probability

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.



Zone 3a: High Probability

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Zone 3b: The Functional Floodplain

This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone where possible (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

Flood Zone maps in this SFRA have been produced from two sources: Environment Agency Flood Zone maps, published and updated quarterly in their website, and detailed local hydraulic modelled outlines.

3.4 Environment Agency Flood Zone Maps

A national flood map dataset has been produced by the Environment Agency. Most fluvial Flood Zones 2 and 3 are derived from the modelling package JFlow, which is a 'coarse' modelling approach (see Appendix C). In many places the results of flood mapping studies have superseded the JFlow outlines. Generally these studies have included detailed hydrological research, surveyed river cross sections, and more precise digital modelling such as ISIS, TuFlow and HecRas.

It should be noted that not all minor watercourses have had Flood Zone maps produced for them. Only watercourses with a catchment area greater than 3km² have been modelled using JFlow software and, therefore, smaller watercourses as identified on the 10K or 25K OS maps within Flood Zone 1 may not be covered by the Environment Agency Flood Zone maps. As such, for any development site located adjacent to an unmapped watercourse within Flood Zone 1, it is recommended that an 8m development easement from the top of bank is applied, and a site specific FRA is undertaken.

The Environment Agency flood maps do not show the functional floodplain, Flood Zone 3b, which is a recent PPS 25 requirement.

4 Flood Risk in the Study Area

4.1 Approach to Data Gathering

Throughout the data collection and review process it has been critical to make best use of the significant amount of information which already exists with respect to flood risk (held by the Council, Environment Agency, British Waterways, the Highways Authority, Severn Trent Water and other key consultees). The team has been able to review the collected data, assess its significance and quality, and advise on which part of the collected data needed to be used for the SFRA. The main approach to the SFRA has been to build on previous studies and gathered information.

Consultation has formed a key part of the data gathering stage of the SFRA. The above stakeholders were consulted during the SFRA and as part of the consultation process, an Inception meeting was held to allow key stakeholders to share their experience and knowledge of flooding issues across the study area. The benefits of adopting a partnering approach (as advocated by PPS25) are significant and have helped to ensure that the findings and recommendations of the SFRA are relevant and workable for the Council.

4.2 Historical Flooding

Recent years have seen a number of large scale flood events throughout the UK including October 1998, autumn 2000, February 2002, New Year 2003, February 2004 and June and July 2007.

During 2007, England experienced the wettest three months to the end of July since records began, with at least twice the average rainfall falling across parts of the country. The extreme conditions led to large scale urban and rural flooding across south-west England, north-east England and the Midlands. Much of the flooding was from a combination of surface water flooding and fluvial flooding.

This study has only found limited anecdotal references to flooding throughout the Stafford Borough. No historical flood outlines were available from the Environment Agency and there was little data from flood management studies.

Despite this, research has shown that the town of Stafford has a history of flooding. It was badly affected in 1946, 1977, 1981 and more recently in 2000 and summer 2007. A scheme to protect the town was undertaken in the 1970s, giving the majority of the town protection to a 1 in 100 year standard (further details in section 6.2). In November 2000, serious flooding was experienced, affecting properties in the Newport Road and Bridge Street the worst. As outlined in section 6.2, a flood alleviation scheme was developed and flood protection has since improved for the Newport Road and Bridge Street area of Stafford.

4.3 Fluvial Flood Risk in Stafford Borough Council as defined by the Flood Zone Maps

The Flood Zone maps provided as part of this study (Volume 2, Tiles B1 – B7) show an indication of the locations at risk from fluvial sources within the Borough. This section summarises the main flood risk areas as defined by the Flood Zone maps and highlights places where there is a significant number of properties within Flood Zones 2 and 3, or where the extent of the Flood Zones is large.

The Trent Catchment Flood Management Plan (CFMP), referred to later in this document, highlights major centres of population on the River Trent and their associated flood risk. One such location is Stone where no risk has been identified from the River Trent, but that flooding is known to occur from

small streams and the urban drainage network. Also mentioned is Stafford, where again no risk has been identified from the River Trent, however, flooding is known to occur from the River Sow and small streams.

The River Trent enters the Borough near Trentham where it passes by Trentham Gardens and Pleasure Grounds which are currently located in Flood Zone 3. From here the river follows the Borough border past the sewage works, also shown to be in Flood Zone 3. As the river turns south, it flows through a rural landscape past Tittensor. Here the floodplain is wide but there is little development affected by fluvial flood risk. The River Trent passes through the centre of Stone, where development has been steered away from the river allowing the natural floodplain to remain. However, Flood Zone 2 currently encroaches on the town in a number of places, namely Abbey Street and Saxifrage Drive.

The Scotch Brook also runs through the town and poses more of a risk than the River Trent. A number of properties located around the confluence of the two watercourses lie in Flood Zone 3. This may be due to reverse flow of the Trent up the Brook, rather than from the Brook alone. There is currently no Flood Zone data available for Aston Brook in Little Stoke.

South of Stone, the floodplain remains wide and affects only the rural landscape. However, the Flood Zones suggest that there could be some interactions during larger flood events with the canal.

At Burston, the Jolpool Brook joins the River Trent and it appears that the majority of the village is located in Flood Zone 3. Again this could be the influence of the River Trent rather than the Jolpool Brook.

The floodplains of the Gayton and Amerton Brooks, both tributaries of the Trent (around the village of Weston) are extensive but again there is little development affected. There is extensive flood risk around the confluence of the rivers Trent and the Sow, and many arterial drains.

The M6 north of Stafford services is currently shown to be in Flood Zone 3, however, it is likely that the motorway is raised above the water levels.

The Doxey Brook, located in the east of the Borough, has much land in Flood Zone 3 which is undeveloped and the risk is low. In Gnosall, there are a few properties on Station Road where the road crosses the Brook, which are deemed to be at risk. There is relatively little risk to property throughout the length of the watercourse, except for the village of Church Eaton, where a number of properties lie within Flood Zone 3.

The Flood Zones for the Rivers Sow and Penk have been updated with outlines from recent modelling work, and a distinction has been made between Flood Zones 3a and 3b. West of Stafford, the Doxey Tillington SSSI nature reserve is an area of extensive floodplain storage, creating an area of wet marshland. At Castletown, the river flows through a narrow corridor. The flood risk from the River Sow through Stafford is relatively low, however, there are a number of drains present and their associated Flood Zone extents affect large areas of the town. The current Flood Zones defined for the Sandyford Brook show a high level of risk to many properties along its route through the town.

The floodplain of the River Penk to the south of the town is easily accommodated and poses little risk to the current development. Fluvial flood risk can be viewed in Volume 2, Tiles B1 – B7.

4.4 Flooding from Other Sources

Methodologies for recording flooding from sources other than fluvial or tidal were not standardised until 2006. Therefore records held of such flooding can be incomplete, or not to a uniform standard. Information has been gathered on flooding experienced from sources other than rivers, and is described in this section.

4.4.1 Flooding from Artificial Drainage Systems and Surface Water Runoff

All Water Companies have a statutory obligation to maintain a register of properties/areas which are at risk of flooding from the public sewerage system, and this is shown on the DG5 Flood Register. This includes records of flooding from foul sewers, combined sewers and surface water sewers which are deemed to be public and therefore maintained by the Water Company. The DG5 register tends to show, to a greater or lesser extent: the date of the most recent incident, the post town, locality, street, post code, a type and problem description, if internal flooding occurred, details of curtilage flooding, and the eastings and northings of the flood incident. The recording of flood events by the authorities has often led to improvements intended to prevent reoccurrence, so historical flooding is not necessarily evidence of propensity for future flooding. Information on flooding caused by surface water runoff can also be obtained from local government, highway authorities and the Environment Agency.

Information on flooding from surface water and artificial drainage sources has been provided by Severn Trent Water (STW) in the form of four digit postcode locations as recorded within their DG5 Flood Register. This information has been digitised and represented as post code areas within a GIS layer. Where a flooding incident has been recorded the whole area is shown as at risk and due to data protection requirements it is not possible to specify the exact location of the incident. Therefore, when the information is displayed on the paper maps the majority of the Borough appears to be affected by flooding, when in fact there may only be 1 property at risk within that particular postcode area. It was therefore decided not to display the affected postcode areas on the paper maps. Instead, a digital GIS layer has been provided which allows the user to view the data within a GIS package and by clicking on a post code area establish the numbers of properties affected within each area. This can be found on the data CD attached to the front cover of this report.

The aim of the DG5 levels of service indicators is to measure the frequency of actual flooding of properties and external areas from the public sewerage system by foul water, surface water or combined sewage. It should be noted that flooding from land drainage, highway drainage, rivers/watercourses and private sewers is not recorded within the register.

When a flood incident is reported to STW, a decision chart is used to assess whether the properties / areas are 'at risk' and then the record is added to the appropriate register. The following registers are currently maintained:

- Properties / areas at risk of flooding twice in ten years or more are added to the 2 in 10 year (2:10) register
- Properties / areas at risk of flooding once in ten years but less than twice in ten years are added to the 1 in 10 year (1:10) register

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- Properties / areas at risk of flooding more once in twenty years but less than once in ten years are added to the 1 in 20 year (1:20)
- Properties / areas at risk of flooding on a greater than 20 year return period are added to the 1:>20yr register

Within the Stafford Borough Council area there are 17 postcode areas identified as at risk of flooding from artificial drainage systems and surface water runoff. Due to the implications of the Data Protection Act on the data held on the DG5 flood register, this report cannot pin-point the exact locations of properties at risk; however, the numbers of properties affected within each post code area, type of register and date of flooding (where available) has been identified and detailed in the table below. The Environment Agency has asked that, should development take place in these areas, further work should be carried out to investigate the nature and scale of the risk posed, so that mitigation can be put in place and the areas can be targeted through appropriate policies for reducing flood risk.

Flooding From Artificial Sources as Recorded in the Severn Trent DG5 Register

Postcode Area	No. Properties Affected
ST11 9	1
ST12 9	9
ST15 0	6
ST15 8	17
ST16 1	13
ST16 3	8
ST17 0	14
ST17 4	7
ST19 9	2
ST18 0	6
ST18 9	6
ST20 0	5
ST21 6	6
ST 3 7	6
ST 4 8	2
TF10 0	10
WS15 3	14

Severn Trent Water has stressed that LPAs should adopt a planning policy requiring the use of SUDS as proposed in PPS25 and that PPS25 should be used to allocate land for development within Flood Zones so that the risk of fluvial flooding is minimised. This reduces the risk of fluvial flood waters entering public foul and surface water sewers and resultant widespread flooding and pollution. Individual developments should be designed so that natural flood pathways are left free of buildings. Further guidance on the application of SUDS can be found in Section 11, and in the CIRIA Report C635, Designing for Exceedance in Urban Drainage (2006).

Highway flooding can occur even when drainage provisions are clean and well maintained. Flooded and waterlogged roads result when the amount of water arriving on the road is greater than the capacity of the drainage facilities that take it away. Exceptional rainfall, a road being in a low lying area, changes in run off from adjacent fields and rivers overflowing are some situations that can lead to the road flooding or being waterlogged even when drains are in good working order. Material carried into the drains by floods can also lead to them becoming blocked. Drainage grills and gratings (e.g. on gullies) can become blocked very quickly when materials like mud are deposited on the road or when there is a heavy fall of leaves.

Consultation with both the Highways Agency and Highways Authority did not result in the return of any data.

4.4.2 Flooding from Impounded Water Bodies

Records of flooding from reservoirs and canals are erratic as there is no requirement for the Environment Agency to show historic flooding from canals and raised reservoirs on plans. In particular, PPS 25 does not require flood risk from canals and raised reservoirs to be shown on the flood map. This is surprising, as overflows from canals are common due to flows from land drainage and their frequent lack of overflows. Occasionally major bank breaches also occur, leading to rapid and deep flooding of adjacent land.

It is important that canals are included in any SFRA as they form a vital land drainage function. Any FRA should therefore take account of canals. Not only do canals occasionally overflow in places due to high inflows from natural catchments (i.e. where inflows are higher than the capacity of the flood control structures), but they are also vulnerable where overtopping occurs from adjacent water courses. Additional water from adjacent watercourses must be routed/conveyed by the canal which may cause issues elsewhere, not only within the catchment of interest but also in neighbouring catchments, as the canal crosses catchment boundaries. Additionally, the canal itself can reduce flood risk where British Waterways (BW) control flood flows within the canal, or accept flood waters either for temporary storage or transfer.

There are three canals located within Stafford Borough Council: the Shropshire Union Canal which runs across the south-west of the Borough, the Trent and Mersey Canal which cuts across the north-east of the Borough and the Staffordshire and Worcester Canal which runs through Stafford. Consultation with British Waterways (BW) has indicated two incidences related to flood risk from the canal (see Volume 2, Tiles B1 – B7):

- A breach at Church Eaton (OS NGR 383414 316983) in 1957
- A breach at High Offley in 1991 due to a culvert failure (OS NGR 377647 325567)

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At present canals do not have a level of service for flood recurrence (i.e. there is no requirement for canals to be used in flood mitigation), although BW, as part of its function, will endeavour to maintain water levels to control the risk of flooding from canals to adjacent properties. It is important, however, that any development proposed adjacent to a canal be investigated on an individual basis regarding flooding issues and should be considered as part of any FRA.

Reservoirs with an impounded volume in excess of 25,000 cubic metres (measured above natural ground level) are governed by the Reservoirs Act 1975 and are listed on a register held by the Environment Agency. Due to high standards of inspection and maintenance required by legislation, normally flood risk from registered reservoirs is moderately low.

There are five bodies of water in Stafford Borough Council identified by the Environment Agency as falling under the Reservoirs Act 1975, tabulated overleaf:

Name	Owner	Grid reference
Black Lake, Knowle Wall Farm	Private	SJ 85600 39600
Bromley Mill Pool	Private	SJ 7790034900
Gap Pool	Private	SJ 84300 24300
Tixall Park Pool	Private	SJ 97200 23700
Trentham Gardens Lake	Private	SJ 86700 40000

The Water Act 2003 requires Reservoir Flood Plans to be produced for specified reservoirs. It is important that arrangements are in place so that Emergency Services, led by Local Authorities, can provide an effective lead in the event of an emergency, which at worst could lead to a reservoir causing a flood following an uncontrolled release of water. The requirement for Reservoir Flood Plans is planned to commence in spring 2009 at the earliest, following direction from the Secretary of State.

4.4.3 Flooding from Groundwater

The Environment Agency can monitor groundwater levels using boreholes and the records of these are held on the WISKI database. Both the Environment Agency and planning authorities can keep records of instances where a high water table has led to individual groundwater flooding events.

Consultation with the Environment Agency has suggested that there are no known problems with flooding from groundwater within Stafford Borough.

5 Strategic Flood Risk Mapping

5.1 Strategic Flood Risk Maps

A key output of the SFRA is a series of maps covering the LPA area, showing flood risk from sources including fluvial, surface water, foul and combined sewers, groundwater and impounded water bodies such as rivers and canals. The maps use the information detailed in section four. The strategic flood risk maps are presented as GIS layers, and can be interrogated to gain the associated descriptive information. These can be found in the CD attached to this report.

Level 1 SFRAs should seek to use Flood Zone outlines which have been produced using detailed modelling techniques in preference to the Environment Agency's Flood Zone maps. When representing the Flood Zones, Level 1 SFRAs should also show the functional floodplain, Flood Zone 3b, where such outlines exist. If Flood Zone 3b has not been produced as part of a detailed modelling project, similar outlines, such as the 1 in 25 year outline can be used, upon agreement with the Environment Agency. In the absence of such detailed information, a precautionary assumption has been adopted where Flood Zone 3b does not exist. When carrying out the Sequential Test the LPA should assume that where Flood Zone 3b does not exist, its extent would be equal to Flood Zone 3a.

This approach is suitable at the Level 1 SFRA stage when carrying out the Sequential Test, a process whereby development should be placed in the lowest risk zone, Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, decision-makers should take into account the flood risk vulnerability of the development and consider reasonably available sites in Flood Zone 2. Only where there are no reasonably available sites in Flood Zones 1 or 2 should decision-makers consider the suitability of sites in Flood Zone 3.

In the absence of a Flood Zone 3b outline, the implications of assuming Flood Zone 3b is equal to Flood Zone 3a can be summarised in the following example. PPS 25 says that 'more vulnerable' developments, such as a housing development, can be placed in Flood Zone 3a provided it passes the Exception Test, but cannot be placed in Flood Zone 3b. If such a development was placed in Flood Zone 3a following the Sequential Test, further modelling work would have to be carried out as part of a Level 2 SFRA to define the extent of Flood Zone 3b, thereby defining the area where the development could not be placed. In the event that detailed modelling work is not possible, the LPA should assume that Flood Zone 3b extends to the 3a extent, and should therefore remove the development from this area. Should a developer wish to prove otherwise, it is at this stage that developer contributions can be given in order to carry out further modelling work. Such a scenario would be expected in an area where the development pressures are significant and there is little other developable land in lower risk areas.

Should sites be placed in Flood Zones 2 or 3, they should always be assessed through a more detailed Level 2 SFRA, which will refine Flood Zone information and allow the development to be located on parts of the site at lowest probability of flooding.

5.1.1 Hydraulic (River) Models

River models and their associated Flood Zone outlines have been collected and used for the production of the SFRA flood maps. Within Stafford Borough Council, two Environment Agency hydraulic models are known to exist which adhere to the SFRM specification: the Rivers Sow and Penk and the Rising Brook.

The SFRM report for the Sow and Penk was completed in March 2006. The River Sow was modelled from head of Main River at Eccleshall (SJ 820 298) to the River Trent confluence at Great Haywood (SJ 997 227) approximately 28km downstream. The River Penk was modelled from the head of Main River at Codsall (SJ 890 037) to the confluence with the River Sow (SJ 947229) approximately 27km downstream. Modelled flood outlines for the River Sow and River Penk were provided by the Environment Agency for the 1 in 100 year event (Flood Zone 3) and the 1 in 1000 year event (Flood Zone 2). These have been used in preference to the current Environment Agency Flood Zones for Flood Zones 2 and 3. In addition, the mapped outline for the 1 in 20 year event (Flood Zone 3b) has been used to produce the Flood Zone 3b outline for the River Sow and Penk watercourses. The 1 in 100 year plus 20% outline also exists and was utilised for the climate change scenario for the 1 in 100 year event (Volume 2, Tile C1).

A hydraulic model exists for the River Trent and Flood Zone 3 has been modelled. Comparison of the Environment Agency's outlines showed that this outline has already been adopted by the Environment Agency, therefore no further work was required to replace the outline. The modelled Flood Zone 3 has been adopted for this study and this, along with the Sow and Penk outlines, can be found in Volume 2, Tiles B1 – B7.

5.2 Climate Change Maps

PPS 25 sets out guidance for changes to flood risk as a result of climate change and this is shown overleaf. These climate change scenarios are now included in most Environment Agency river models and flood outlines are produced; for older river studies this is less likely.

The main Climate Change table from PPS 25 is shown below:

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

In its November 2006 publication of the predicted effects of climate change on the United Kingdom, DEFRA described how short duration rainfall could increase by 30% and flows by 20%, and suggests winters will become generally wetter. These effects will tend to increase both the size of Flood Zones associated with the sea and rivers, and the amount of flooding experienced from "other sources".

As described in section 5.1, the climate change outline for Flood Zone 3 has been produced for the Sow and Penk and this has been used on the SFRA climate change maps. Modelled climate change outlines do not exist for the remainder of the watercourses, nor do other modelled scenarios such as the 1 in 1000 or 1 in 200 year outlines, which can often be used to simulate the 1 in 100 year climate change outline, as they often show similar extents to the climate change scenarios of the 100 year event.

Therefore on all other watercourses, the most up-to-date Environment Agency Flood Zone maps have been used. A 1 in 100 year climate change scenario has been produced by assuming that Flood Zone 2 (1 in 1000 year return period) will become Flood Zone 3 (1 in 100 year return period). We have also assumed that Flood Zone 3a (1 in 100 year return period) will become the functional flood plain (Flood Zone 3b, 1 in 20 year return period). This is a precautionary approach but one which is consistent with our past modelling experience, which has shown that the 1 in 1000 year flood outline is often similar to the climate change scenario for the 100 year event. The LPA might wish to use the climate change maps to carry out the Sequential Test, in order to give a particularly long-term risk-based approach to planning.

This is the level of detail which PPS25 requires for a Level 1 SFRA, and gives an indication of how Flood Zones and flood probabilities are likely to change over time. The climate change scenarios are provided in a series of maps covering the study area (Volume 2, Tiles C1).

6 Flood Warning Systems and Flood Risk Management Measures

6.1 Flood Risk Management

Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response.

6.1.1 Catchment Flood Management Plans

A CFMP is a high-level strategic plan through which the Environment Agency seeks to work with other key-decision makers within a river catchment to identify and agree long-term policies for sustainable flood risk management. One CFMP covers Stafford Borough: the River Trent CFMP.

The River Trent CFMP is currently being undertaken for the River Trent catchment and at the time of production of this SFRA, the document had been released for consultation (closing 28th January 2008). The study considers flooding over an area covering the River Trent catchment and all of its tributaries, which is a total area of over 10,000 square kilometres. The document gives an overview of flood risk in the River Trent catchment and sets out a preferred plan for sustainable flood risk management over the next 50 - 100 years. The document is currently in draft form and therefore it is possible that changes will be made to the text referred to overleaf. The current draft and final document will be available on the Environment Agency's website.

The Environment Agency and their partners have developed policies to manage flood risk in the future. These policies will help achieve their vision for a more sustainable, cost effective and natural approach to managing flood risk. The policy options are detailed below.

Trent CFMP Policy Options

Policy option	Policy
1	No active intervention (including flood warning and maintenance), Continue to monitor and advise
2	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
3	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
4	Take further action to sustain current scale of flood risk in the future (responding to the potential increases in flood risk from urban development, land use change, and climate change
5	Take further action to reduce flood risk (now and in the future)
6	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, for example for habitat inundation).

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The Trent catchment and that of its tributaries has been divided into 10 policy units. Each policy unit has been assessed to decide which policy will provide the most appropriate level and direction of flood risk management for both now and the future. Out of the six standard flood risk management policies listed above, one has been applied to each policy unit. These policies have been agreed nationally and are being applied to CFMPs in a standard way across England and Wales.

The allocation of the policies to each unit involved the review of large amounts of information, alongside feedback and extensive consultation and consideration was given to how the policy units would interact with each other. The policy units of importance to Stafford Borough Council are policy units 6 and 7.

Policies were chosen on how well the policy actions would meet catchment objectives, the tables below provide a summary of the main factors considered when selecting the most appropriate policy option for each of the policy units. The section also indicates likely consequence of implementing each policy.

Policy unit 6	Mid Staffs and Lower Tame
<p>Problem / risk</p>	<p>Physical characteristics:</p> <ul style="list-style-type: none"> • South East Lowland area of upper Trent is predominately pasture with open arable areas, wooded heights above the wide, shallow central valley. Arden area wooded farmland landscape with rolling hills. North eastern industrial area based around former Warwickshire coalfield. Lower broad flat flood plains of the Tame and Trent confluence. • Triassic mudstones dominate the geology within this Policy Unit. • Soil Predominantly loamy with small areas of sandy soil. Area vulnerable to high run-off rates and soil erosion. • Cannock Chase Area of Outstanding Natural Beauty (AONB). Area of high sandstone heather and bracken heathland with birch woodland and extensive pine plantations. <p>Flood mechanism:</p> <ul style="list-style-type: none"> • The watercourses within the policy unit are relatively natural with few flood defences. Flooding occurs as a result of overtopping banks or embankments. <p>Receptor (Areas affected):</p> <ul style="list-style-type: none"> • Main towns at risk are Rugeley, Tamworth and Rocester. • SAC – Pasturefields Salt Marsh, River Mease. • SSSI – Whitacre Heath, Middleton Pool, Alvecote Pools, Blithfield Reservoir, River Blythe. • NNR – Chartley Moss • Landscape designations: Cannock Chase – Area of Outstanding

	<p>Natural Beauty (AONB)</p>
	<p>Flood risk:</p> <ul style="list-style-type: none"> Flood risk is assessed as generally low, but medium at Tamworth due to the number of relatively high number of properties located behind the existing defences. <p>Potential source of future flood risk</p> <ul style="list-style-type: none"> Climate change Land use change Urbanisation
	<p>Opportunities and constraints:</p> <p><i>Opportunities:</i></p> <ul style="list-style-type: none"> Improved efficiencies and more effective flood risk management. Flood risk reduction through changes in land management. Improved efficiencies through more focused and targeted maintenance. Utilise disused aggregate workings for flood risk management. <p><i>Constraints:</i></p> <ul style="list-style-type: none"> Large number of small settlements potentially at risk. Existing aggregate extraction.
	<p>Policy unit objectives:</p> <ul style="list-style-type: none"> Minimise disruption to people and communities caused by flooding in Tamworth and other smaller settlements along the Trent corridor, taking into account future climate change and development pressure. Reduce the disruption caused by flooding to transport and infrastructure. Sustain and protect cultural and social heritage in the policy unit. Sustain and improve the status of environmentally designated areas through appropriate frequency, extent and duration of flooding, including using rivers and floodplains to benefit nature conservation. Reduce soil erosion resulting from rapid surface water run-off, particularly where there has been significant ground disturbance caused by mining (Staffordshire) and where sandy soils are prone to erosion such as Cannock Chase. Return watercourses to a more natural state, increasing biodiversity and opening up green river corridors through urban areas.

	<ul style="list-style-type: none"> • Sustain and increase the amount of BAP habitat in the catchment. • Support and encourage land management and drainage practices, particularly from Staffordshire coal mining areas that will protect and improve water quality.
Policy selected	Policy option 6 - Take action
Justification	<p>Large rural area, with low flood risk (AAD = £17.8m)</p> <p>Future flood risk is unlikely to increase significantly in the future (Future scenario AAD = £26.9m) – main driver for change is climate change.</p> <p>Main source of flood risk is Tamworth which can be managed by attenuation elsewhere and by allowing more space for flood plain inundation through Tamworth itself.</p> <p>Flooding downstream in policy unit 5 (Burton, Derby and Nottingham) can be reduced in parts by applying policy 6 in this policy unit.</p> <p>Policy 6 meets policy unit objectives downstream in policy unit 5.</p>
Alternative policies considered	<p>Policy 1 - do nothing. The current level of management is considered justifiable to prevent an unacceptable increase in flood risk.</p> <p>Policy 2 – reduce current level of flood risk management. As with policy option 1, the potential damages and losses would be unacceptable under a ‘do less’ policy.</p> <p>Policy 3 – maintain current level of flood risk management. Although the current level of flood risk is considered acceptable, it has been shown that flood damages will increase in the future.</p> <p>Policy 4 – maintain the current level of flood risk into the future. The current level of risk is not considered excessive and so this policy is not justified.</p>
Uncertainties and dependencies	<p>This policy selection is largely dependant on our assessment of current and future flood risk being relatively low, and that more sustainable flood risk management options will be sufficient to maintain an acceptable level of flood risk within the policy unit.</p> <p>The success of this policy depends on being able to manage flood risk in Tamworth effectively.</p>

Policy unit 7	West Staffs
<p>Problem / risk</p>	<p>Physical characteristics:</p> <ul style="list-style-type: none"> • The Staffordshire Plain consists of unified rural landscape dominated by dairy farming with little woodland. Varied landscape around Lichfield with a range of industrial, residential, agricultural and recreational land use. • Predominantly Triassic mudstones and harder millstone grit in the upper reaches at the edge of the Peak District.
	<p>Flood mechanism:</p> <ul style="list-style-type: none"> • Overtopping of riverbanks or river walls. • Surface water drainage.
	<p>Receptor (Areas affected):</p> <ul style="list-style-type: none"> • Urban areas of Stoke-on-Trent, Stone and Stafford. • Ramsar – Cop Mere (Part of the Midland Meres and Mosses) • SAC – Cannock Extension Canal. • SSSI – Doxey and Tillington Marshes. • NNR – Motte Meadows.
	<p>Flood risk:</p> <ul style="list-style-type: none"> • Flood risk at Stoke-on-Trent, Stone and Stafford is assessed as low. • Relatively fast response to rainfall and high velocities due to steep upper catchment. <p>Potential source of future flood risk</p> <ul style="list-style-type: none"> • Climate change. • Land use change. • Urbanisation.
	<p>Opportunities and constraints:</p> <p><i>Opportunities:</i></p> <ul style="list-style-type: none"> • Pull back from the river front through re-generation and planning control providing a riverside green corridor through urban areas. <p><i>Constraints:</i></p> <ul style="list-style-type: none"> • Urban growth required to meet planning targets and beyond. • Natural habitats will constrain areas for future development, concentrating

	<p>future development in certain locations.</p> <p>Policy Appraisal Objectives:</p> <ul style="list-style-type: none"> • Minimise disruption to people and communities caused by flooding, taking into account future climate change and urban growth. • Minimise the increase in the cost of flood damage, taking into account extensive future urban growth in the policy unit. • Return watercourses to a more natural state, increasing biodiversity and opening up green river corridors through Stoke-on-Trent and other urban areas.
Policy selected	Policy option 4 – Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk in urban development, land use change and climate change).
Justification	<p>Currently mainly rural catchment with two significant urban areas of Stoke on Trent and Stafford, but with relatively low flood risk (AAD = £3.2m).</p> <p>This policy unit has been identified as a likely growth area. This future urban growth is likely to be a driver for change which will affect future flood risk. Although it is impossible to predict how much of this new development will directly place people at risk from flooding, the potentially increasing flood risk may be considerably more than our broadscale modelling suggests (i.e. future scenario AAD = £4.0m not including any aspect of the expected urban growth).</p> <p>Policy 4 provides a framework which accepts the current level of flood risk, but supports actions required to prevent flood risk increasing in the future.</p>
Alternative policies considered	<p>Policy 1 – do nothing. Significant urban areas currently benefit from flood defence schemes. Without these schemes the damages and losses would be considerably larger. This policy, therefore, could not be considered as an alternative.</p> <p>Policy 2 – reduce current level of flood risk management. As with policy option 1, the potential damages and losses in the future would increase unacceptably under a ‘do less’ policy.</p> <p>Policy 3 – maintain current level of flood risk management, although the current level of flood risk is acceptable, our broadscale model has shown that the cost of flood damage will increase in the future as a result of climate change, and is likely to increase still further as a result of urban growth. This policy, therefore, does not meet the objectives of minimising future increases in disruption and cost of flooding.</p> <p>Policy 5 – reduce the level of flood risk, both now and in the future. The current level of risk in this policy unit is considered moderate and therefore this policy is not justified.</p>

	Policy 6 – increase flooding to reduce flood risk elsewhere. There are no real opportunities for this approach within the policy unit. Any benefits resulting from policy 6 in this policy unit will be to policy units located downstream.
Uncertainties and dependencies	<p>Our assessment of flood risk is based primarily on areas of main river that have been modelled, but also supported by historic flood records.</p> <p>The assessment of the impacts of climate change is simplistic and is only indicative of what may happen in the future.</p> <p>There is significant uncertainty in future urban growth estimates and locations, and the impact on flood risk that growth would have. It is also unknown to what extent it will be possible to retreat from the rivers edge and open up green corridors through urban areas.</p> <p>This policy is based on the assumption that flood risk will increase significantly in the future as a result of both climate change and urban growth.</p>

6.1.2 Flood Risk Management Strategies

The Environment Agency advocates a strategic approach to flood risk management on a 'whole catchment' basis. In line with this thinking, a number of Flood Risk Management Strategies have been undertaken by the Environment Agency within the Midlands region.

In 2005, the Environment Agency produced a Flood Risk Management Strategy for the River Trent, which has been reviewed for inclusion in this study. The study spanned from Stoke-on-Trent, where the River Trent's head of Main River is located, to the tidal limit at Cromwell Weir downstream of Newark, a distance of some 200km. The principal aim of the Fluvial Trent Strategy is to identify the preferred high level approaches for sustainable management of flood risk along the River Trent corridor over the next 50 years.

The strategy is limited to the Trent corridor only, and while local catchment wide solutions (i.e. of the tributaries) are appraised in some instances, flood risk along the Trent corridor is mainly considered. The Trent flows through the length of Stafford Borough, directly through Stone. Here, the floodplain has been left relatively undeveloped and as such, flood risk posed by the Trent here is relatively low. In fact, Stone does not feature on the table which shows flood risk hotspots along the Trent corridor. The Trent was split into to 99 independent flood cells and flood risk management options were appraised for each. The flood cells from the south of Stoke-on-Trent to just upstream of Rugeley (flood cells 1.10 to 2.7) are not described as key flood risk hotspots, and for this reason, flood risk management options and subsequent appraisals are not considered in the strategy. However, at the south-eastern end of Stafford Borough, a flood cell begins just downstream of the Trent/Sow confluence to the Borough's boundary with Lichfield District (flood cell 2.8). This comes under the 'Rugeley' Flood Risk Location, and the option includes creating on-line storage by reducing aqueduct pass through flow at the northern end of Rugeley. This would require a dam to encompass flow and the storage would alleviate flood flows downstream. This option was not recommended because it was felt that the aqueduct might have historic significance and might increase flood risk upstream, which would affect Stafford Borough.

Nonetheless, the strategy identifies a number of options which are considered best practice and are recommended. These recommendations are supported by PPS 25 requirements and indeed the main messages of this SFRA, which considers these options in more detail. These include:

- SUDS: either retrofitted or on new developments
- Development Control: appropriate measures to restrict inappropriate developments
- Land Management: Appropriate land management techniques that could reduce surface runoff
- Floodplain Obstructions: the removal of such obstructions, where appropriate, to improve local conveyance.

A scheme to enhance land management practises, Farming Floodplains for the future: South Staffordshire Washlands, has recently been launched. Recent problems with flash flooding of large areas of land, such as those experienced in 2000, have shown that new approaches to flood risk management are needed. In the past, farmers were encouraged to drain their land and rivers were deepened to help take water away faster. This can lead to exacerbated flooding problems downstream. The Defra initiative is aiming to work in collaboration with farmers and others to encourage management of important rivers and streams flowing into them and surrounding land in lowland Staffordshire. This innovative and holistic approach to flood risk management will introduce more sustainable methods to land management - in line with the principles of Defra's *Making Space for Water*. The project will concentrate on the River Sow flowing through Stafford, the River Penk flowing north through Penkridge, and the River Trent flowing south from Stoke on Trent to Burton upon Trent.

6.2 Flood Defences

Flood defences are structures which affect flow in times of flooding and therefore prevent water from entering property. They generally fall into one of two categories: 'formal' or 'informal'. A 'formal' defence is a structure which has been specifically built to control floodwater. It is maintained by its owner (this is not necessarily the Environment Agency) so that it remains in the necessary condition to function. An 'informal' defence is a structure that has not necessarily been built to control floodwater and is not maintained for this purpose. This includes road and rail embankments and other linear infrastructure (buildings and boundary walls) which may act as water retaining structures or create enclosures to form flood storage areas in addition to their primary function.

A study of informal defences has not been made as part of this assessment. Should any changes be planned in the vicinity of road or railway crossings over rivers in the study, it would be necessary to assess the potential impact on flood risk to ensure that flooding is not made worse either upstream or downstream. Smaller scale informal defences should be identified as part of site-specific detailed FRAs and the residual risk of their failure assessed.

In accordance with the scope of a Level 1 SFRA, a high level review of formal flood defences has been carried out using data from the NFCDD. This is a good starting point for identifying significant flood defences and potential areas benefiting from defence, but the quantity and quality of information provided differs considerably between structures. The NFCDD is intended to give a reasonable indication of the condition of an asset and should not be considered to contain consistently detailed and accurate data (this would be undertaken as part of a Level 2 SFRA where the need arises).

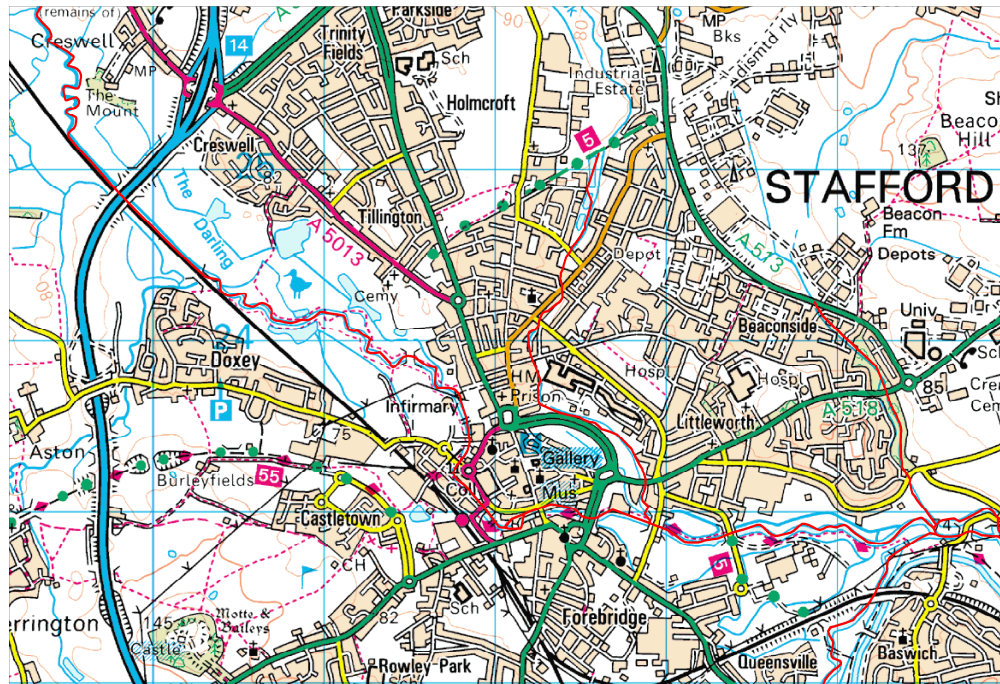
The NFCDD identifies the following flood defence structure in the Borough:

- In the village of Millmeece, approx 287m of the railway embankment and an archway through the embankment are classified as flood defence structures and are maintained by the Environment Agency.
- In Yarnfield there is a weir on a small watercourse running through the village over a weir which is maintained by the Environment Agency to provide flood defence.
- In Stafford there are a few place where flood defences have been installed these include, a pond and reed bed on the Marston Brook adjacent to the Aston fields industrial park which is maintained by the Environment Agency. Also a few sections of floodwall and bridge abutment at Meadow Bridge in the town centre which are listed as being under private ownership.
- A scheme to protect Stafford town was undertaken in the 1970's, giving the majority of the town protection to a 1 in 100 year standard. In 1994 an asset survey identified that problems were developing at the river edge in Victoria Park, caused by the poor ground conditions in Stafford. In November 2000, Stafford experienced serious flooding, with properties in the Newport Road and Bridge Street areas being worst affected. A flood alleviation scheme was developed and completed in 2004 to replace existing piling which was in need of repair. Flood risk through the centre of Stafford has been reduced, and the construction of a new flood defence wall near Green Bridge has improved flood protection for the Newport Road and Bridge Street area of Stafford.

Research carried out for this study uncovered a Defra article (dated April 2007) stating that the Environment Agency's 5-year capital works scheme includes the Scotch Brook in Stone, though no further details were uncovered.

6.3 Storage Areas

West of Stafford the Doxey Tillington SSSI nature reserve is an area of extensive floodplain storage, creating an area of wet marshland. The marshes provide an area of extensive floodplain through the town of Stafford. The area is classified a nature reserve and a SSSI, and provides 300 acres of wet grassland. The River Sow and a number of arterial drains pass through the reserve and periodically breach, subjecting the marshes to flooding. The area was created due to subsidence as a result of local brine pumping. This formed a distinct area of open water locally known as flashes. There has been little change in the management of the marshes from the middle ages to the mid twentieth century. In 1979, the Severn Trent Water Authority carried out flood alleviation work which involved the re-grading and deepening of the Sow throughout the site, resulting in a 25% increase in capacity and a fall in water levels of around 1m. However, there are concerns that this has had a detrimental affect on the Marshes by decreasing their ability to detain water for any length of time, and the Environment Agency, in partnership with the Sow and Penk IDB, are looking to restore the hydrology of the marshes (information obtained from the Wildlife Trust: www.wildlifetrusts.org). The location of the marshes is shown overleaf (denoted by a duck symbol), and provides a substantial flood risk management measure for Stafford, storing flood water prior to the watercourse (denoted by a red line) flowing through the narrow channel through the centre of the town.



Natural storage areas, i.e. undeveloped floodplain, are in abundance in Stafford. It is imperative that these are protected and continue to be used as a means of attenuation of flood waters. They should also be maintained to ensure their efficient operation during a flood event. If the storage areas are not maintained this may lead to an increased risk of flooding at locations downstream.

6.4 Residual Risk

In producing Flood Zone maps the Environment Agency takes the presence of defences into account by showing the area that benefits from the defence (ABD). This area can also be deemed an area which is at risk of defence overtopping or failure. It can therefore also be described as a residual risk zone. Residual flood risks can arise due to:

- The failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system
- A severe flood event that exceeds a flood management design standard and results in, for example, overtopping.

Despite the fact that defences exist in the study area and * protect properties there are no Areas Benefiting from Defences (ABDs) contained within the Environment Agency's ABD database. This is because modelling work has not been carried out to define the ABD area. With each defence there is a residual risk of overtopping, breach or blockage, which could result in significant damage to buildings and highway infrastructure as well as posing danger to life. It is possible that future modelling work undertaken by the Environment Agency may lead to the availability of such information and therefore the flood maps should be updated if this information becomes available. Areas of residual risk are treated uniformly and are represented in the GIS as a simple outline of the expected affected area. Actual levels of residual risk will vary spatially depending on flow routes, velocities, flood depths and proximity to the breach or overtopping location. In the event that the

Exception Test needs to be applied to specific site allocations, the scope of the SFRA should be extended to a Level 2 assessment to refine information on the flood hazard in these locations.

Scotch Brook through Stone is prone to soil and bank erosion, made worse by aggregate being removed upstream. It transports and deposits significant amounts of loose material, including fine material, gravel, boulders and fallen trees. This can block the channel or any structures along the watercourse, reducing their capacity, and therefore presenting residual risk. Additionally, poorly maintained trash screens and rubbish inappropriately dumped in watercourses in urban areas can cause a residual risk if structures become blocked.

All structures and defences are mapped in Volume 2, Tile A1. These should be referenced by those proposing development to identify the possibility of localised residual risks as well as opportunities for de-culverting and restoring the natural channel.

6.5 Existing Flood Warning System

The Environment Agency is the lead organisation on flood warning and its key responsibilities include direct remedial action to prevent and mitigate the effects of an incident, to provide specialist advice, to give warnings those likely to be affected, to monitor the effects of an incident and to investigate its causes. This requires the Agency, local authorities and the emergency services to work together to protect people and properties. Stafford Borough falls within the Central area of the Midlands Region of the Environment Agency.

When conditions suggest that flood are likely, it is the responsibility of the Environment Agency to issue flood warnings to the Police, Fire and Rescue Service, to the relevant local authorities, to the public and to the flood wardens. It is the responsibility of individuals in the community to receive flood warnings via Flood warnings Direct (FWD) which passes messages over the telephone network.

A flood warning system is in operation for the main rivers within the Borough of Stafford and is outlined below in four stages.

- **Flood Watch:** Flooding of low lying land and roads is expected. Be aware, be prepared, watch out! The following actions are recommended:

- Watch water levels
- Stay tuned to local radio or TV
- Ring Floodline on 0845 988 1188
- Make sure you have what you need to put your flood plan into action
- Alert your neighbours, particularly the elderly
- Check pets and livestock
- Reconsider travel plans
- Consult the Environment Agency's website:



http://environment-agency.gov.uk/subjects/flood/?version=1&lang=_e;

Flood Watch Areas can be seen in Tile E1, Volume 2. Flood Watches are issued for expected flooding, which could occur anywhere within the Flood Watch Area but with low or minor impact. The trigger for Flood Watch is a forecast that flooding of low impact land is expected.

Three flood watches areas are in operation within the Borough of Stafford and these are:

- Midlands, Upper Severn 2 (covering the western segment of the Borough)
- Midlands, Upper Trent 3 (covering Stafford)
- Midlands, Upper Trent 4 (covering the Trent corridor)
- **Flood Warning:** Flooding of homes and businesses is expected. Act now! The following actions, in addition to those associated with Flood Watch, are recommended:
 - Move pets, vehicles, food, valuables and other items to safety
 - Put sandbags or floodboards in place
 - Prepare to turn off gas and electricity
 - Be prepared to evacuate your home
 - Protect yourself, your family and others that need your help

The flood warning areas in the Borough of Stafford are illustrated in Tile E1, Volume 2. The service is currently set up to warn properties within the 1% Annual Exceedance Probability (1 in 100 year event) and the 0.1% Annual Exceedance Probability (1 in 1000 year event). The following locations are currently covered by the Environment Agency Flood Warning System:

- River Trent from Darlaston to Great Haywood
- Rising Brook in the Silkmore Lane area of Stafford
- River Penk from Coven to Stafford
- River Sow and River Penk
- River Trent from Knypersley to Darlaston
- River Blithe from Blythe Bridge to Blithfield
- **Severe Flood Warning:** Severe flooding is expected. There is extreme danger to life and property. Act now! The following actions, in addition to those associated with Flood Warning, are recommended:
 - Be prepared to lose power supplies - gas, electricity, water, telephone
 - Try to keep calm, and to reassure others, especially children
 - Co-operate with emergency services and local authorities
 - You may be evacuated

- **All Clear:** Flood Watches or Warnings are no longer in force. The following is recommended:
 - Flood water levels receding
 - Check all is safe to return
 - Seek advice

Within the Borough of Stafford the following Severe Flood Warning areas are in operation:

- River Penk from Coven to Stafford
- River Trent from Knypersley to Darlaston
- River Trent from Darlaston to Great Haywood

6.6 Flood Response Plan

Stafford Borough Council is a Category 1 Responder as defined in the Civil Contingencies Act 2004. Accordingly, this Council works closely in Staffordshire with the Staffordshire Civil Contingencies Unit, emergency services, other local authorities, health authorities and various other organisations. The Council's website directs users to a website called <http://www.staffordshireprepared.gov.uk/>. This website has been produced to offer information for the people of Staffordshire, its visitors and businesses on preparations for, and responses to, emergencies and major incidents within Staffordshire.

The Council recognises that there is an need for effective planning for civil emergencies to ensure the efficient and speedy management of the response to these incidents between all the possible agencies; the Police, Fire Brigade, Ambulance Service, the Council, utilities providers and voluntary agencies. The purpose of the Council's emergency planning is to provide its staff with the plans, procedures and information they will require to enable them to ameliorate the effects of any major emergency occurring within Stafford Borough Council, whilst allowing Council services to continue to provide as far as possible their usual day to day services. The Council's emergency plans set out the information, procedures and details required to ensure an effective, flexible and timely response to an emergency thus reducing to a minimum the distress and disruption caused by such an incident.

It is recommended that the Council's Emergency Response Plan is reviewed and updated in light of the findings of the SFRA to ensure that safe evacuation and access for emergency services is possible during times of flood both for existing developments and those being promoted as possible sites within the LDF process. It is further recommended that the Council works with the Environment Agency to promote the awareness of flood risk to maximise the number of people signed up to the FWD service (previously this has involved targeted mail shots to those identified as living within Flood Zone 3a). Within the study area particular attention should be given to vulnerable people including those with impaired hearing or sight and those with restricted mobility.

With respect to new developments, those proposing the development should take advice from the LPA's emergency planning officer and for large-scale developments, the emergency services, when producing an evacuation plan as part of a FRA. As a minimum these plans should include information on:

How flood warning is to be provided:

- Availability of existing warning systems
- Rate of onset of flooding and available warning time and
- Method of dissemination of flood warning

What will be done to protect the infrastructure and contents:

- How more easily damaged items could be relocated
- The potential time taken to respond to a flood warning
- Ensuring safe occupancy and access to and from the development
- Occupant awareness of the potential frequency and duration of flood events
- Provision of safe (i.e. dry) access to and from the development
- Ability to maintain key services during an event
- Vulnerability of occupants and whether rescue by emergency services may be necessary and feasible
- Expected time taken to re-establish normal practices following a flood event

In some areas, particularly for existing properties and proposed developments behind defences, it may be necessary to extend the scope of the SFRA to Level 2. The outputs from detailed overtopping and breach analysis of the key defences will provide refined hazard information on flood depths, velocities and flow paths, which could be used by the LPA emergency planning teams to define new or refine existing emergency plans for these areas.

7 Flood Risk Management Policy Considerations

7.1 Overview

This chapter provides recommendations for what should be included in the Council's policy for flood risk management. Council policy is considered essential to ensure that the recommended development control conditions can be imposed consistently at the planning application stage.

The policy recommendations provided in this chapter are not exhaustive and it is therefore recommended that the Council refers to the following key flood risk management documents in order to fully inform their own flood risk management policies:

- **Planning Policy Statement 25: Development and Flood Risk** – sets out national policy for development and flood risk and supports the Government's objectives for sustainable communities.
- **River Trent CFMP** - strategic planning document through which the Environment Agency will work with other stakeholders to identify and agree policies for long-term flood risk management over the next 50 to 100 years. The findings of the draft Trent CFMP have been summarised in section 6.1.1; however it is recommended that the final report is reviewed once complete and any changes to the draft incorporated into this document.
- **Making Space for Water** - outlines the Government's proposals for forward planning of flood management over the next 20 years advocating a holistic approach to achieve sustainable development. The protection of the functional floodplain is central to the strategy.
- **Water Framework Directive** - European Community (EC) water legislation which requires all inland and coastal waters to reach good ecological status by 2015.

7.2 Policy Considerations

A key aim of an SFRA is to define flood risk management objectives and identify key policy considerations. It should be noted that it is ultimately the responsibility of the Council to formally formulate these policies and implement them.

It is recommended that the following flood risk objectives are taken into account during the policy making process and, where appropriate, used to strengthen or enhance the development control policies provided in section 7.3.

Flood Risk Objective 1: To Seek Flood Risk Reduction through Spatial Planning and Site Design:

- Use the Sequential Test to locate new development in least risky areas, giving highest priority to Flood Zone 1
- Use the Sequential Test within development sites to inform site layout by locating the most vulnerable elements of a development in the lowest risk areas. For example, the use of low-lying ground in waterside areas for recreation, amenity and environmental purposes can provide an effective means of flood risk management as well as providing connected green spaces with consequent social and environmental benefits

- Build resilience into a site's design (e.g. flood resistant or resilient design, raised floor levels)
- Identify long-term opportunities to remove development from the floodplain through land swapping
- Ensure development is 'safe'. For residential developments to be classed as 'safe', dry pedestrian egress out of the floodplain and emergency vehicular access should be possible. The Environment Agency states that dry pedestrian access/egress should be possible for the 1 in 100 year return period event, and residual risk, i.e. the risks remaining after taking the sequential approach and taking mitigating actions, during the 1 in 1000 year event, should also be 'safe'.

Flood Risk Objective 2: To Reduce Surface Water Runoff from New Developments and Agricultural Land:

- SUDS required on all new development. As outlined in section 10.3 which outlines appropriate SUDS techniques for the Borough, infiltration systems should be the preferred means of surface water disposal, provided ground conditions are appropriate. Above ground attenuation, such as balancing ponds, should be considered in preference to below ground attenuation, due to the water quality and biodiversity benefits they offer.
- All sites require the following:
 - Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency
 - 1 in 100 year on-site attenuation taking into account climate change
- All new developments require SUDS
- Space should be specifically set aside for SUDS and used to inform the overall site layout
- Promote environmental stewardship schemes to reduce water and soil runoff from agricultural land

Flood Risk Objective 3: To Enhance and Restore the River Corridor:

- An assessment of the condition of existing assets (e.g. bridges, culverts, river walls) should be made. Refurbishment or/and renewal should be made to ensure the lifetime is commensurate with lifetime of the development. Developer contributions should be sought for this purpose.
- Those proposing development should look for opportunities to undertake river restoration and enhancement as part of a development to make space for water. Enhancement opportunities should be sought when renewing assets (e.g. de-culverting, the use of bioengineered river walls, raising bridge soffits to take into account climate change)
- Avoid further culverting and building over of culverts. All new developments with culverts running through their site should seek to de-culvert rivers for flood risk management and conservation benefit
- Set development back from rivers, seeking an 8 metre wide undeveloped buffer strip

Flood Risk Objective 4: To Protect and Promote Areas for Future Flood Alleviation Schemes

- Protect Greenfield functional floodplain from future development (our greatest flood risk management asset) and reinstate areas of functional floodplain which have been developed (e.g. reduce building footprints or relocate to lower flood risk zones)
- Develop appropriate flood risk management policies for the Brownfield functional floodplain, focusing on risk reduction
- Identify sites where developer contributions could be used to fund future flood risk management schemes or can reduce risk for surrounding areas
- Seek opportunities to make space for water to accommodate climate change

Flood Risk Objective 5: To Improve Flood Awareness and Emergency Planning

- Seek to improve the emergency planning process using the outputs from the SFRA
- Encourage all those within Flood Zone 3a and 3b (residential and commercial occupiers) to sign-up to Flood Warnings Direct service operated by the Environment Agency
- Ensure robust emergency (evacuation) plans are implemented for new developments greater than 1 Ha in size

7.3 Development Control Policies

For the purposes of development control, detailed policies will need to be set out to ensure that flood risk is taken account of appropriately for both allocated and non-allocated 'windfall' sites. The following reflects the minimum requirements under PPS25 (reference should be made to Tables D.1-D.3 in PPS25).

Future Development within Flood Zone 1

In this zone, developers and local authorities should realise opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development. There is no significant flood risk constraint placed upon future developments within the Low Probability Flood Zone 1, although for sites greater than one hectare or above, the vulnerability from other sources of flooding should be considered as well as the effect of the new development on surface water runoff.

Typically, a Drainage Impact Assessment will be required to demonstrate that runoff from the site is reduced, thereby reducing surface water flood risk. This will involve the use of SUDS techniques which should take into account the local geological and groundwater conditions. For all sites, the post development runoff volumes and peak flow rates should be attenuated to the Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency.

Future Development within Flood Zone 2

Land use within Medium Probability Flood Zone 2 should be restricted to the 'water compatible', 'less vulnerable' and 'more vulnerable' category. Where other planning pressures dictate that 'highly vulnerable' land uses should proceed, it will be necessary to ensure that the requirements of the Exception Test are satisfied. The following should be considered:

- A detailed site-specific FRA should be prepared in accordance with PPS25 and Council Development Control policies
- Floor levels should be situated above the 100 year plus climate change predicted maximum level plus a minimum freeboard of 600mm
- The development should be safe, meaning that dry pedestrian access to and from the development should be possible above the 1 in 100 year plus climate change flood level and emergency vehicular access should be possible during times of flood.
- SUDS should be implemented to ensure that runoff from the site (post development) is reduced. For all sites, the post development runoff volumes and peak flow rates should be attenuated to the Greenfield discharge rates with a minimum reduction of 20% as required by the Environment Agency, for both Greenfield and Brownfield sites. Space should be set aside for SUDS.
- The proposed development should be set-back from the watercourse with a minimum 8m wide undeveloped buffer zone, to allow appropriate access for routine maintenance and emergency clearance.

Future development within High Probability Flood Zone 3a

Land use with High Probability Flood Zone 3a should be restricted to the 'less vulnerable' uses to satisfy the requirements of the Sequential Test. For 'more vulnerable' uses it is necessary to ensure that the requirements of the Exception Test are satisfied. The following should be considered:

- A detailed site-specific FRA should be prepared in accordance with PPS25 and Council Development Control policies. Properties situated within close proximity to formal defences or water retaining structures (reservoirs/canals) will require a detailed breach and overtopping assessment to ensure that the potential risk to life can be safely managed throughout the lifetime of the development. The nature of any breach failure analysis should be agreed with the Environment Agency.
- The development should not increase flood risk elsewhere, and opportunities should be taken to decrease overall flood risk (such as use of SUDS and de-culverting). This can be achieved by developing land sequentially, with areas at risk of flooding favoured for green space.
- Floor levels should be situated above the 1% (100 year) plus climate change predicted maximum level plus a minimum freeboard of 600mm. Within defended areas the maximum water level should be assessed from a breach analysis.
- The development should allow dry pedestrian access to and from the development above the 1 in 100 year plus climate change flood level and emergency vehicular access should be possible

during times of flood. An evacuation plan should be prepared. With respect to new developments, those proposing the development should take advice from the LPAs emergency planning officer and for large-scale developments, the emergency services, when producing an evacuation plan as part of a FRA. All access requirements should be discussed and agreed with the Environment Agency.

- Basements should not be used for habitable purposes. Where basements are permitted for commercial use, it is necessary to ensure that the basement access points are situated 600 mm above the 1 in 100 year flood level plus climate change.
- SUDS should be implemented to ensure that runoff from the site (post development) is reduced. For all sites, the post development runoff volumes and peak flow rates should be attenuated to the Greenfield discharge rates with a minimum reduction of 20%, as required by the Environment Agency for both Greenfield and Brownfield sites. Space should be set aside for SUDS.
- The proposed development should be set-back from the watercourse with a minimum 8m wide undeveloped buffer zone, to allow appropriate access for routine maintenance and emergency clearance.

Future development within Functional Floodplain Zone 3b

Development should be restricted to 'water-compatible uses' and 'essential infrastructure' that has to be there. Table D2 from PPS 25 (reproduced in Section 1.5.1 of this report) outlines the types of development included within this classification. It should be noted that 'essential infrastructure' includes essential transport infrastructure (including mass evacuation routes) which may have to cross the area at risk as well as strategic utility infrastructure such as electricity generating power station and grid and primary substations. Reference should be made to Table D2 of PPS 25 when considering development within Flood Zone 3b to ensure only appropriate development is considered. 'Essential infrastructure' in this zone must pass the Exception Test and be designed and constructed to remain operational in times of flood and not impede water flow.

7.4 Council Specific Policy Issues

It is recommended that the aforementioned policy considerations are included in the Council's policies. It is also recommended the Trent CFMP flood risk management policies (specifically those in Policy Units 6 and 7) are reviewed and incorporated.

The Sow and Penk IDB Policy Statement on Flood Protection and Water Level Management, 2005, states that the Board operates under the Land Drainage Act 1991 and manages adopted outfalls, pumping stations and watercourses to maintain water levels in its District to serve the community in general. The policy aim is:

"To reduce the risk to people and the developed and natural environment from flooding and coastal erosion by encouraging the provision of technically, environmentally and economically sound and sustainable defence measures."

Recent key flood risk management documents including Making Space for Water, the Water Framework Directive, PPS 25 and the Trent CFMP advocate a very different approach to that stated above. In contrast, these documents place strong emphasis on the use of good planning to ensure

new development is not placed in Flood Zones 2 and 3, specifically by using the Sequential Test, as well as restoring, enhancing and utilising the natural river corridor as a means of flood risk management. This is in strong preference to the use of man-made defences. It is therefore strongly recommended that the Council ensures that their policies place emphasis on the points outlined in section 7.2, to ensure compliance with National guidance and policy, in preference to that stated by the IDB.

7.5 Sensitive Development Locations

Assuming that future site allocations and windfall sites are guided by PPS25 and the recommendations provided in this report, there are few locations in which development would significantly increase flood risk elsewhere. In the main, any development in the recognised storage areas and functional floodplain would have a detrimental effect and would increase flood risk downstream of these locations.

Locations particularly sensitive to the issues mentioned above are the Scotch Brook in Stone and the Sandyford Brook in Stafford. The catchment of the Scotch Brook is some 20km² and extends from Meir Heath in the north, out to Hilderstone in the east and down through Oulton in the west. Development anywhere in this catchment has the potential to influence the flood response of the Brook and increase flood risk downstream. It is the same situation for the Sandyford Brook. The catchment of brook is relatively narrow catchment of 8km² extending as far north as Marston then confined to only 500m either side of the brook as it runs through Stafford. Again any development in this catchment has the potential to influence the flood response of the Brook and increase flood risk downstream.

There are a large number of environmentally valuable sites within the Borough of Stafford, including nature reserves, Sites of Specific Scientific Interest (SSSIs) and conservation areas including the Trent and Mersey canal. An increase in water levels on any of the Main Rivers in the catchment would not only have the potential to affect properties in Flood Zones 2 and 3, but the impact on these area must also be considered.

It is also important to consider cross border issues, where development upstream could impact on areas within the Stafford Borough. The Flood Zones of the River Penk through Stafford are already very close to the developed areas and an increase in flood volumes in this location would pose a significant threat to existing development.

In general, throughout the study area, any development (including developments in Low Probability Flood Zone 1) which does not incorporate SUDS may increase the risk of surface and/or fluvial flooding both on-site and off-site (downstream). As such effective development control policies should be implemented in accordance with the SUDS recommendations provided in this report.

8 Guidance on the Application of the Sequential Test

This section provides guidance on how to apply the Sequential Test.

8.1 Step One: Strategic Overview of flood risk across all potential development areas

The recommended initial step is to determine the extents of potential land allocations on large scale maps showing the most up-to-date flood zones, in accordance with PPS 25. Summary tables of flood risk issues should then be prepared for each location, indicating if the potential areas overlap Zones 2, 3, localised flooding areas or if there are records of previous flood incidents shown in the maps. It is then recommended that the summary tables and proposed locations are sent to the Environment Agency for verification. Particular care should be taken by identifying allocations that could increase flood risk elsewhere (flood incident points, localised flooding areas, flood zones) and lack of dry access.

8.2 Step Two: Flood Risk Issues in Zone 1

The next step should be to analyse all potential sites within Zone 1 by identifying those that have any flood risk issues (for example those affected by other sources of flooding or those that do not have dry access routes during flood events).

For the sites with flood risk issues, an assessment of likely significance of flood risk should then be carried out in terms of likely probability of flooding and potential consequences/flood damages (advice from a drainage specialist may be required, such as the SFRA consultant, the Environment Agency, a highways drainage engineer and/or the planning authority drainage specialist). The purpose is to identify sites with significant flood risk - high probability of flooding and significant flood damages with deep flooding and high velocities which could result in loss of property and potentially loss of life.

If a site with significant flood risk is identified within Zone 1, this would be considered as if it was in the High Probability Zone 3a, for further application of the Sequential Test in Zone 3a (see Section 8.3), bearing in mind that if a more vulnerable land use is required for the site, it will have to pass the Exception Test.

For those sites within localised flooding areas or with flood incident records where flood risk issues are not significant (for example shallow flooding and non-frequent blockages, etc), development should still be acceptable provided that adequate policies are in place for mitigating the risk (for example contributions may be required from the developer for the upgrade of the surface water system in the area).

It is important to note that most potential sites that pass the Sequential Test in Zone 1 will still require site-specific FRAs. For development proposals on sites comprising one hectare or greater, the vulnerability to flooding from other sources (as well as from river flooding) and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water runoff, should be incorporated in an FRA. This need only be brief unless the factors above or other local considerations require particular attention. It is recommended that FRAs are still produced for Zone 1 sites of less than one hectare, at locations where there are records of previous flood incidents.

8.3 Step Three: Sequential Test in Zones 2 and 3

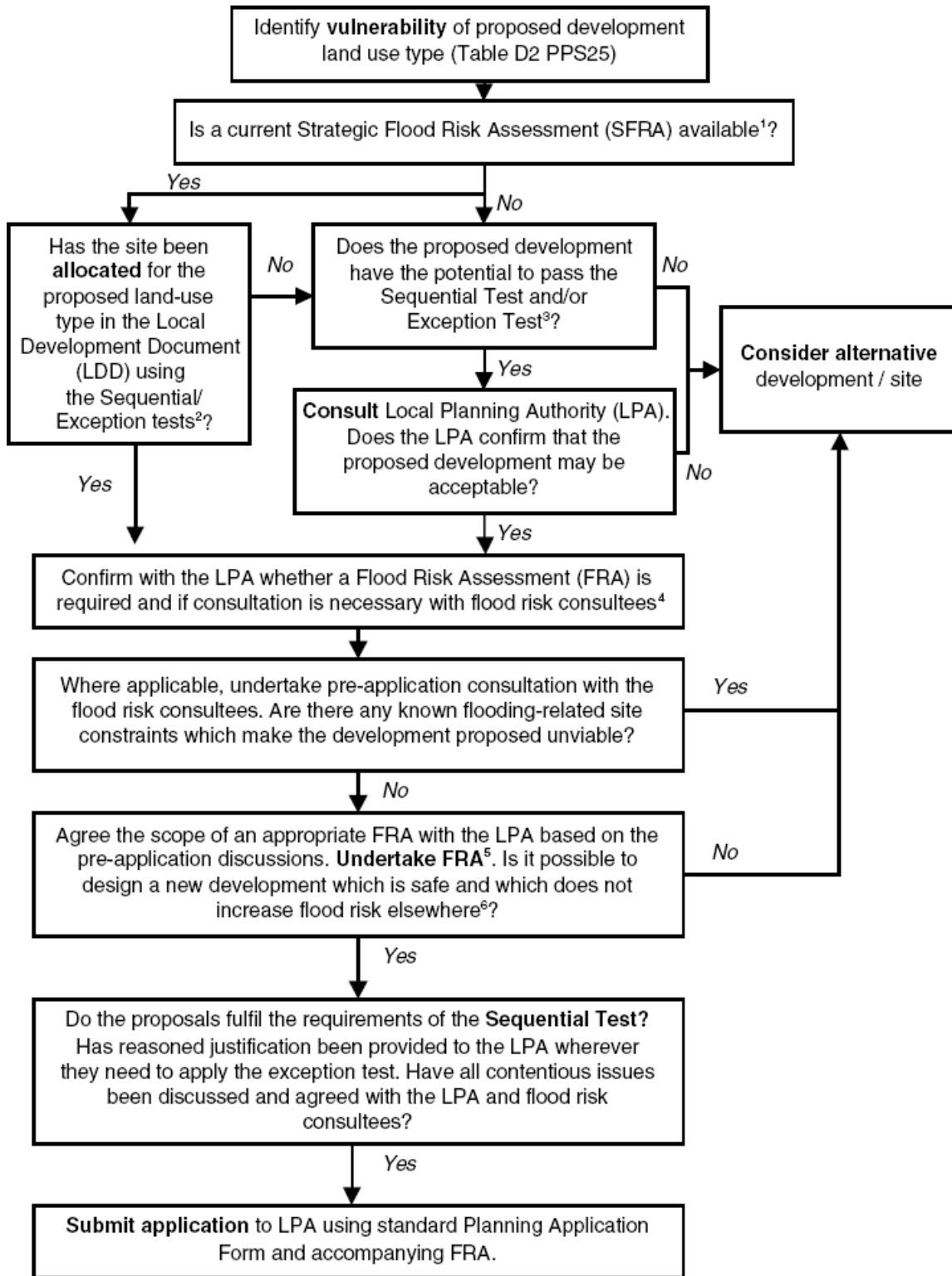
The third step is to sequentially allocate sites and as part of an SA. It is recommended that prior to incorporating the Sequential Test within the SA, the following actions take place:

- a) Apply the measure of avoidance/prevention by moving the boundaries of the potential sites away from Zones 2, 3a and 3b, for those cases where the loss of site area is acceptable. This is generally the case at locations where the loss in area is of the order of 10%.
- b) Provisionally adopting land uses that are fully compatible with the vulnerability classification of PPS 25, to try to avoid the need to apply the Exception Test where possible.

9 Guidance for Developers

A SFRA is a strategic document that provides an overview of flood risk throughout the study area. Site-specific FRAs will be required for most proposed developments and the level of detail will depend on the level of flood risk at the site (see general details about FRA requirements in Appendix E in PPS25). The onus is on the developer to provide this information in support of a planning application.

Since the release of PPS25 in December 2006, the Environment Agency has power of direction over the determination of planning applications, which can be refused on the grounds of flood risk. Should the Council wish to disregard the advice of the Environment Agency then in exceptional circumstances the planning application could be put before the Secretary of State. It is therefore imperative that developers hold discussions over the need for FRAs early on within the planning process. Consultation should be undertaken with the Environment Agency and the relevant Council to ensure that the Council's policies on flood risk management are respected and taken account of, and that the scope of the FRA is commensurate with the level of flood risk. The following reflects best practice on what should be addressed within a detailed FRA. Those proposing development should also be directed towards Annex F of PPS25 (the figure overleaf shows the recommended process of undertaking an FRA as part of an individual planning application).



Guidance for developers for individual planning applications

9.1.1 Proposed Developments within Functional Floodplain Flood Zone 3b

In line with PPS25, development will not normally be allowed in the Functional Floodplain unless it is classified as a 'water compatible' or 'essential infrastructure' use. Table D2 from PPS 25 (refer to Section 1.5.1 of this report) details the type of developments classified as 'water compatible' or 'essential infrastructure.'

9.1.2 Proposed Developments within High Probability Flood Zone 3a

All FRAs supporting proposed development within High Probability Zone 3a should assess the proposed development against all elements of the Council's flood policy, and include an assessment of the following:

- The vulnerability of the development to flooding from other sources (e.g. surface water drainage, groundwater) as well as from river flooding. This will involve discussion with the Council and the Environment Agency to confirm whether a localised risk of flooding exists at the proposed site.
- The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change), i.e. maximum water levels, flow paths and flood extents within the property and surrounding area. The Environment Agency may have carried out detailed flood risk mapping within localised areas that could be used to underpin this assessment. Where available, this will be provided at a cost to the developer. Where detailed modelling is not available, hydraulic modelling by suitably qualified engineers will be required to determine the risk of flooding to the site.
- The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment to be carried out by a suitably qualified engineer.
- It is highlighted that all forms of flooding need to be considered as localised flooding may also occur, typically associated with local catchment runoff following intense rainfall passing directly over the Borough. This localised risk of flooding must also be considered as an integral part of the detailed FRA.
- A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable. Measures may include flood defences, flood resistant and resilient design, escape/evacuation, effective flood warning and emergency planning.
- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum.

It is essential that developers thoroughly review the existing and future structural integrity of informal defences, if present, upon which the development will rely (i.e. over the lifetime of the development), and ensure that emergency planning measures are in place to minimise risk to life in the unlikely event of a defence failure. This would be particularly important for development that could potentially be affected as a result of a breach of any of the canals in the study area.

9.1.3 Proposed Development within Medium Probability Zone 2

For all sites within Medium Probability Zone 2, a scoping level FRA should be prepared based upon readily available existing flooding information, sourced from the Environment Agency. If there is a significant flood risk from other sources (e.g. groundwater or sewer flooding) is identified then a more detailed FRA should be prepared. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed throughout, for example, the provision of raised floor levels and the provision of planned evacuation routes or safe havens.

9.1.4 Proposed Development within Flood Zones 1 and 2

The risk of alternative sources of flooding (e.g. surface water, sewage, and/or groundwater) must be considered, and SUDS techniques must be employed to ensure no worsening of existing flooding problems elsewhere within the area.

The SFRA provides specific recommendations with respect to the provision of sustainable flood risk mitigation opportunities that will address both the risk to life and the residual risk of flooding to development within particular 'zones' of the area. These recommendations should form the basis for the site-based FRA.

9.2 Raised Floor Levels and Basements (Freeboard)

The raising of floor levels above the 1 in 100 year peak flood level will ensure that the damage to property is minimised. Given the anticipated increase in flood levels due to climate change, the adopted floor level should be raised above the 1% probability flood level assuming a 20% increase in flow over the next 20 to 100 years.

It is highlighted that many of those areas currently situated within Medium Probability Zone 2 could become part of the High Probability Zone 3. This is important as it means that properties that are today at relatively low risk will, in 20 to 100 years, be within High Probability Zone 3a. It is imperative therefore that planning and development control decisions take due consideration of the potential risk of flooding in future years.

Wherever possible, floor levels should be situated a minimum of 600 mm above the 1% probability peak flood level plus climate change flood level (+20% flows), determined as an outcome of the site-based FRA. Additional freeboard may be required because of the risk of blockages to the channel, culvert or bridge. The height that the floor level is raised above the flood level is referred to as the 'freeboard', and is determined as a measure of residual risks.

The use of basements within flood affected areas should be discouraged. Where basements are permitted however, it is necessary to ensure that the basement access points are situated a minimum of 600 mm above the 1% probability flood level plus climate change. The basement must have unimpeded access and waterproof construction to avoid seepage during flooding conditions. Habitable uses of basements within Flood Zone 3 should not be permitted, while basement dwellings can be allowed in Flood Zone 2 provided they pass the Exception Test.

9.2.1 Development Behind Defences

Areas behind defences are at particular risk due to breach or overtopping, resulting in the rapid on-set of fast-flowing, deep water flooding with little or no warning. Risks will therefore be highest closest to these defences and as such it is recommended that the LPAs should set back developments and ensure that those proposing developments develop robust evacuation plans as part of their FRA in consultation with the Environment Agency.

Consideration of flood risk behind defences should be made as part of detailed FRAs. Developers should review Volume 2, Tile A1 to determine the location of structures and defences in proximity to the site and therefore identify the possibility of localised residual flood risk. The FRA should take into account:

- The potential mechanisms of failure of flood defence infrastructure
- The standard of protection and design freeboard
- The asset condition of the flood defence
- The height of the flood defence infrastructure and retained water levels compared to ground levels
- The potential location, width and invert level of breach(es) in the flood defences
- The duration of water levels during a flood event or tidal cycle
- The period it would take the operating authority to close the breach
- The period it would take for water to drain from the flooded area following a breach or overtopping event

In addition to the above it is recommended that should any development be proposed in a defended flood area, the potential cumulative impact of loss of storage on flood risk elsewhere should be considered.

9.2.2 Car Parks

Car parking may be appropriate in areas subject to shallow, low velocity flooding (in High Probability Zone 3a) provided sufficient flood warning is available, and appropriately located and worded signs are in place. However, this would need to be discussed and agreed with the LPA and Environment Agency. As part of a FRA, the developer should consider the likelihood of people being able to move their cars within the flood warning time.

9.3 Developer Contributions

If new developments are placed on Flood Zones 2 or 3, it might be necessary for local infrastructure to be increased. With regards to flood risk, it might also be necessary to extend flood warning system coverage, or increase the maintenance of flood defences. The LPA and other authorities might wish to request developer contributions to cover the cost of this, and if so this should be achieved through a Section 106 Legal Agreement.

10 Guidance for the Application of Sustainable Drainage Systems

10.1 Introduction

PPS1: Delivering sustainable development and PPS25 requires that LPAs should promote SUDS. LPAs should therefore ensure policies encourage sustainable drainage practices in their LDDs. SUDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed, reducing the rate of discharge from urban sites to Greenfield runoff rates is one of the most effective ways of reducing and managing flood risk within the Borough.

10.2 Types of SUDS Systems

SUDS may improve the sustainable management of water for a site by:

- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- reducing volumes of water flowing directly to watercourses or sewers from developed sites;
- improving water quality compared with conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- reducing potable water demand through rainwater harvesting;
- improving amenity through the provision of public open space and wildlife habitat;
- replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

Any reduction in the amount of water that originates from any given site is likely to be small however if applied across the catchment, the cumulative affect from a number sites could be significant.

There are numerous different ways that SUDS can be incorporated into a development. The appropriate application of a SUDS scheme to a specific development is heavily dependent upon the topography and geology of the site and the surrounding areas. Careful consideration of the site characteristics is necessary to ensure the future sustainability of the adopted drainage system. When designing surface water drainage systems, the Environment Agency states that climate change should be taken into account appropriate to the predicted lifetime of the development, and designed to account for the predicted increases in rainfall intensity, as outlined in the table in section 3.5.

The most commonly found components of a SUDS system are described below:

- Pervious surfaces: Surfaces that allow inflow of rainwater into the underlying construction or soil.
- Green roofs: Vegetated roofs that reduce the volume and rate of runoff and remove pollution. They comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/ landscaping/ permeable car parking, over a drainage layer. They are designed to intercept and retain precipitation, reduce the volume of runoff and attenuate peak flow.

- Filter drains: Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
- Filter strips: Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
- Swales: Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
- Basins: Ponds and wetlands areas that may be utilised for surface runoff storage.
- Infiltration Devices: Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
- Bioretention areas: Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground.
- Pipes and accessories: A series of conduits and their accessories normally laid underground, that convey surface water to a suitable location for treatment and/or disposal (although sustainable, these techniques should be considered where other SUDS techniques are not practicable).

The Environment Agency requires both Greenfield and Brownfield sites to achieve Greenfield discharge rates with a minimum reduction of 20% to account for the future effects that climate change will have on runoff volumes.

For more guidance on SUDS, the following documents and websites are recommended as a starting point:

- PPS 25
- Practice Guide Companion to PPS 25
- The SUDS Manual – CIRIA C697 (2007) provides the best practice guidance on the planning, design, construction, operation and maintenance of SUDS and facilitates their effective implementation within developments.
- CIRIA c644 – Green Roofs (2007) provides guidance on the design, construction and operation of Green Roofs. The guidance also describes how ‘quick wins’ for biodiversity can be achieved in the built environment by incorporating nesting and roosting boxes for birds, bats and other animals.
- Interim Code of Practice for Sustainable Drainage Systems, National SUDS Working Group, 2004
- www.ciria.org.uk/suds/

10.3 Application of SUDS for Stafford Borough Council

This area has a mixture of slowly permeable and freely draining, slightly acidic, loamy and clayey soils, with some areas of naturally high groundwater. The more permeable sites should have priority given to infiltration drainage techniques, as opposed to discharging surface water to watercourses. Where less permeability is found and infiltration techniques that rely on discharge into the existing soils are not viable (due to a high water table, source protection zones, contamination etc), discharging site runoff to watercourses is preferable to the use of sewers. Integrated urban drainage should also be used throughout the design process.

The entire Borough has been highlighted by DEFRA as a Nitrate Vulnerable Zone (NVZ) and there are significant areas in the west, south and north of the area classified as a Groundwater Source Protection Zone (GSPZ) by the EA. Any boreholes, water wells or other extraction points should also be identified and taken into account in the design process.

NVZs are generally indicative of the agricultural nature of the surrounding land and the use of fertilisers. Nitrate levels in many English waters are increasing principally due to surface water runoff from agricultural land entering receiving water bodies. The level of nitrate contamination will have an impact on the choice of SUDS and will have to be assessed for specific sites.

The GSPZ is situated over the local aquifers and is designated as inner, outer and total catchment areas. The Inner Zones of the GSPZ are the most sensitive areas and vary in diameter from 0.1 to 0.7 kilometres. The Outer Zones are also sensitive to contamination and vary in diameter from 0.4 to 6.5 kilometres. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination.

Nineteen GSPZ Inner Zones have been identified by the EA in the Stafford Borough and they are situated in the following areas:

- North-east area: Cresswell, Meir, Meir Heath, Moddershall and three in Fulford
- Northern area: Cranberry, Millneece and three in Swynnerton Coles
- North-west area: Croxton
- Western area: Knighton, Weston Jones and Gnosall
- Central area: Haughton
- South-east area: Millford and Brocton

Runoff which is likely to be heavily contaminated must be treated by a proprietary device, which should be carefully considered to ensure the correct system is selected to remove pollutants. PPS 3 (2006) states that source control SUDS must be considered and incorporated where suitable. For example; surface water drained from a car park should implement a filter bed wherever possible before considering an interceptor device to remove contaminants.

If the local soil is contaminated then a lined system is generally required. This may include a drainage design which allows infiltration in the upper layer, but should incorporate an impermeable layer at its base to prevent contamination. In such cases lined underground attenuation storage is used to store a 1 in 100 year +20% (for climate change) storm event and discharges into a nearby watercourse.

11 Recommendations

A number of recommendations have been made throughout this report on the basis of the findings of the SFRA. These are summarised below.

11.1 Site Allocation Process

It is recommended that the outputs from this study are used as an evidence base from which to direct new development to areas of low flood risk (Flood Zone 1). Where development cannot be located in Flood Zone 1, The Council should use the flood maps to apply the Sequential Test to their remaining land use allocations.

Where the need to apply the Exception Test is identified, due to there being an insufficient number of suitable sites for development within zones of lower flood risk, the scope of the SFRA will need to be widened to a Level 2 assessment. The need for a Level 2 SFRA cannot be fully determined until the Council has applied the Sequential Test. It is recommended that as soon the need for the Exception Test is established, Level 2 SFRA(s) are undertaken by a suitably qualified engineer so as to provide timely input to the overall LDF process.

11.2 Council Policy

It is recommended that for the purpose of clarity, a Supplementary Planning Document should be developed in light of the suggested policies and guidance notes, outlining the minimum requirement of the Environment Agency in response to PPS25.

It is recommended that the following core considerations should be included within the Council's flood risk management policy documents:

- Protecting the functional floodplain from development
- Directing vulnerable development away from flood affected areas
- Ensuring all new development is 'Safe', meaning that dry pedestrian access to and from the development is possible without passing through the 1 in 100 year plus climate change floodplain, and emergency vehicular access is possible
- Promoting the use of SUDS in all Flood Zones for both Brownfield and Greenfield sites, to achieve Greenfield discharge rates with a minimum reduction of 20%. Space should be set-aside for SUDS.
- Safeguarding possible sites for flood storage and other channel works
- Seeking developer contributions (to be determined in consultation with the Environment Agency) via S106 planning obligations to fund (or part fund) strategic flood risk management facilities and bring benefit to the wider community.

11.3 Emergency Planning

It is recommended that the Council's Emergency Response Plan is reviewed and updated in light of the findings of the SFRA to ensure that safe evacuation and access for emergency services is possible during times of flood both for existing developments and those being promoted as possible sites within the LDF process. It is further recommended that the Council works with the Environment

Agency to promote the awareness of flood risk and encourage communities at risk to sign-up to the Environment Agency Flood Warning Direct service.

11.4 Future Updates to the SFRA

The SFRA should be retained as a ‘living’ document and reviewed on a regular basis in light of better flood risk information and emerging policy guidance. It is recommended that outputs from the following studies are used to update future versions of the SFRA report and associated maps:

- Trent CFMP
- Flood risk mapping studies
- Strategies

11.4.1 Missing or Incomplete Data

Data gaps have been assessed throughout the Level 1 SFRA data collection and review exercise. This has flagged the missing or incomplete data, which should be incorporated into the SFRA as it becomes available.

Data	Description	Source
Flood outlines	1 in 20 year return period (or similar – to allow production of Flood Zone 3b), for all rivers except the Rivers Sow and Penk.	Environment Agency (this data does not yet exist)
CFMP	River Trent CFMP – Final version	Environment Agency (Document in production)
Surface water flooding records	The Highways Agency and Highways Authority were consulted with regards to the availability of their own records of flooding instances. Receipt of this data is still awaited.	Highways Agency and Highways Authority

It should be noted that any further updates to the Flood Zones carried out by the Environment Agency as a results of further modelling work undertaken under the SFRM contract, should be incorporated into the SFRA. This information is made available from the Environment Agency in the form of quarterly updates.

11.5 Level 2 SFRA

This Level 1 SFRA will allow the Council to assess their current proposed site allocations using the Sequential Test. This will act as a ‘sieving’ process, allocating as many sites as possible to Flood Zone 1. Where it is found that some sites can only be placed in Flood Zones 2 and 3, the Exception Test will need to be applied. In order for developments to go ahead in such areas a number of criteria should be satisfied:

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

DPD has reached the 'submission' stage (see Figure 4 of PPS12: Local Development Frameworks) the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal

- The development should be on developable, previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land
- A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall

A Level 2 SFRA should be viewed as rather more site specific than a Level 1 SFRA, addressing flood risk to potential development sites which have gone through the Sequential Test and have been located in Flood Zones 2 or 3.

The data required for a Level 2 SFRA will therefore depend upon which, if any, of the council's final list of preferred sites remain in Flood Zones 2 & 3 following application of the Sequential Test and hence where the Exception Test needs to be applied.

In instances where Flood Zone 3b does not exist (and therefore for the purposes of the sequential test Flood Zone 3b is deemed to be equal to 3a), and a 'more vulnerable' development has been allocated in Flood Zone 3a, it may be necessary to define Flood Zone 3b using flood mapping techniques. Halcrow is able to advise on further work required if this situation arises.

It is important that a Level 2 SFRA considers the variation of flood risk in a Flood Zone due to flood risk management measures i.e. flood defences. This increased scope involves a more detailed review of flood hazard (flood probability, flood depth, flood velocity, rate of onset of flooding). If development is to be located behind defences, it would be necessary to model constructional failure of the defence (breach) and water levels rising to exceed the level of the defence (overtopping). It is not necessary to carry out such scenarios behind all existing defences, if no new development is to be located behind these structures. In some instances improvements to existing flood defences may be required to manage residual flood risks. Here, the Level 2 SFRA should include an appraisal of the extent of works to provide or raise the flood defence to appropriate standard. Should sites become allocated behind defences, Halcrow can advise on the cost of such work, and whether existing data is suitable for this purpose.

Level 2 SFRA outputs would include:

- An appraisal of the condition of flood defence infrastructure and likely future policy
- An appraisal of the probability and consequence of breach or overtopping of flood defence infrastructure
- Maps showing distribution of flood risk across zones
- Guidance on appropriate policies for making sites which satisfy parts a) and b) of the Exception Test safe, and the requirements for satisfying part c) of the Exception Test
- Guidance on the preparation of FRAs for sites with varying flood risk across the flood zone

12 References/Glossary

- 1) **AEP** - Annual Exceedance Probability, for example 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years).
- 2) **Core Strategy** - The Development Plan Document which sets the long-term vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.
- 3) **DEFRA** - Department of Environment, Food and Rural Affairs Development.
- 4) **Development Plan Document (DPD)** - A spatial planning document within the Council's Local Development Framework which set out policies for development and the use of land. Together with the Regional Spatial Strategy they form the development plan for the area. They are subject to independent examination.
- 5) **Dry pedestrian egress** - Routes to and from buildings that will remain dry and allow pedestrian/wheelchair evacuation to dry land in times of flood.
- 6) **Environment Agency** - The leading public body for protecting and improving the environment in England and Wales.
- 7) **Environment Agency Flood Map** - Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency.
- 8) **Environmental Stewardship** - Environmental Stewardship is a new agri-environment scheme which provides funding to farmers and other land managers in England who deliver effective environmental management on their land. The scheme is intended to build on the recognised success of the Environmental Sensitive Areas scheme and the countryside Stewardship Scheme. Flood risk management is among its secondary objectives.
- 9) **Exception Test** - If, following application of the Sequential Test, it is not possible (consistent with wider sustainability objectives) to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed, the Exception Test may apply. PPS 25 sets out strict requirements for the application of the Test.
- 10) **Flood Estimation Handbook** - The latest hydrological approach for the estimate of flood flows in UK.
- 11) **Flood Risk Management Hierarchy** - PPS 25 reaffirms the adoption of a risk-based approach to flooding by following stepped hierarchical measures at all stages in the planning process. Avoidance/prevention is the first measure, followed by substitution, control and then mitigation.
- 12) **Flood Risk Vulnerability** - PPS 25 provides a vulnerability classification to assess which uses of land maybe appropriate in each flood risk zone.
- 13) **Formal Flood Defence** - A structure built and maintained specifically for flood defence purposes.
- 14) **Functional Floodplain Zone 3b** - Defined as areas at risk of flooding in the 5% AEP (20 year) design event.

- 15) **Habitable Room** - A room used as living accommodation within a dwelling but excludes bathrooms, toilets, halls, landings or rooms that are only capable of being used for storage. All other rooms, such as kitchens, living rooms, bedrooms, utility rooms and studies are counted.
- 16) **High probability Zone 3a** - Defined as areas at risk of flooding in the 1% AEP (100 year) design event.
- 17) **IDB** – Internal Drainage Board, responsible for non-main rivers and drainage within their boundary area.
- 18) **Informal Flood Defence** - A structure that provides a flood defence function however has not been built and/or maintained for this purpose (e.g. boundary wall).
- 19) **JFLOW** - A computer river model based on routing a flood calculated by Flood Estimation Handbook methodology along a river corridor the levels of which are derived from a Side Aperture Radar (SAR) remote sensed Digital Terrain Model.
- 20) **Land Swapping** - looking for long term opportunities to remove development from areas that flood at present and relocate in lower risk locations which is essentially restoration of the floodplain.
- 21) **LiDAR** - Light Detection and Ranging (LiDAR) is an airborne terrain mapping technique which uses a laser to measure the distance between the aircraft and the ground.
- 22) **Local Development Framework** - The Local Development Framework (LDF) consists of a number of documents which together form the spatial strategy for development and the use of land.
- 23) **Low Probability Zone 1** - Defined as areas outside Zone 2.
- 24) **Main River** – A section of watercourse (including the structures and devices on it used to regulate flow) which is maintained by the Environment Agency.
- 25) **'Making Space for Water' (Defra 2004)** - The Government's new evolving strategy to manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches, so as: a) to reduce the threat to people and their property; b) to deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles, c) to secure efficient and reliable funding mechanisms that deliver the levels of investment required.
- 26) **Medium probability Zone 2** - Defined as areas at risk of flooding in events that are greater than the 1% AEP (100 year), and less than the 0.1% AEP (1000 year) design event.
- 27) **mAOD** – Metres above Ordnance Datum
- 28) **NFCDD** – National Flood and Coastal Defence Database, owned by the Environment Agency, containing details of the location, standard and condition of all Environment Agency maintained defences
- 29) **Ordinary Watercourse (non-main river)** – Any section of watercourse not designated as a main river.
- 30) **Planning Policy Statements** - The Government has updated its planning advice contained within Planning Policy Guidance Notes (PPGs) with the publication of new style Planning Policy Statements (PPSs).
- 31) **Planning Policy Statement 25 (PPS 25): Development and Flood Risk** - PPS 25 reflects the general direction set out in 'Making Space for Water'.

- 32) **Previously Developed (Brownfield) Land** - Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example a house and its garden would be considered to be previously developed land.
- 33) **Residual Risk** - The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.
- 34) **Return Period** – The probability of a flood of a given magnitude occurring within any one year e.g. a 1 in 100 year event has a probability of occurring once over 100 years. However, a 1 in 100 year event could occur twice or more within 100 years, or not at all.
- 35) **Sequential Test** - Informed by a SFRA, a planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed.
- 36) **Sow & Penk Internal Drainage Board** – Policy Statement on Flood Protection and Water Level Management, 2005
- 37) **Strategic Flood Risk Assessment (SFRA)** - A Strategic Flood Risk Assessment is used as a tool by a planning authority to assess flood risk for spatial planning, producing development briefs, setting constraints, informing sustainability appraisals and identifying locations of emergency planning measures and requirements for flood risk assessments.
- 38) **Supplementary Planning Document (SPD)** - Provides supplementary guidance to policies and proposals contained within Development Plan Documents. They do not form part of the development plan, nor are they subject to independent examination.
- 39) **Sustainability Appraisal (SA)** - Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.
- 40) **Sustainable Development** - Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (The World Commission on Environment and Development, 1987).
- 41) **West Midlands Regional Spatial Strategy** - This is a new Regional Spatial Strategy which identifies the vision for the region. It will set a new housing requirement for each District or Borough.

