



Solihull  
Level 2 Strategic  
Flood Risk  
Assessment

Living Document

December 2014

Prepared for:



UNITED  
KINGDOM &  
IRELAND



**47064259 Solihull Level 2 Strategic Flood Risk Assessment**

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**GLOSSARY OF TERMS**

TERM	DEFINITION
1D Hydraulic Model	Hydraulic model which computes flow in a single dimension, suitable for representing systems with a defined flow direction such as river channels, pipes and culverts.
2D Hydraulic Model	Hydraulic model which computes flow in multiple dimensions, suitable for representing systems without a defined flow direction including topographic surfaces such as floodplains.
Annual Exceedance Probability (AEP)	Annual exceedance probability (AEP) of occurrence in any one year, expressed as a percentage. For example, a 1 in 200 annual exceedance probability event has a 0.5% AEP of occurring in any year.
CDA	Critical Drainage Area. A discrete geographic area (usually a hydrological catchment) where a single, multiple or interlinked source(s) of flood risk (surface water, groundwater, sewer, ordinary watercourse, and/or main river) cause flooding thereby affecting people, property or local infrastructure.
Climate Change (CC)	Climate change. When included as part of a flood event scenario, it means that that scenario includes the anticipated effects of climate change. For fluvial events, it incorporates a 20% increase in river flow and for rainfall events, a 30% increase. These climate change values are based upon information within the National Planning Policy Framework (NPPF) and accompanying Planning Practice Guidance (March 2014) and the earlier Planning Policy Statement (PPS) 25: Development and Flood Risk Practice Guide.
Culvert	A covered channel or pipe that carries water below the level of the ground.
Defra	Department of Environment, Flood and Rural Affairs
Development Plan	Consists of the Local Plan (Core Strategy and site-specific development documents, produced by Local Planning Authorities (LPAs) or groups of LPAs, Proposals Map and Neighbourhood Plans (produced by Parish Councils or Neighbourhood Forums).
DSM / DTM	Digital Surface Model / Digital Terrain Model. Digital representation of ground surface topography (unfiltered and filtered i.e. vegetation, buildings and parked cars removed using an algorithm).
Exception Test	Conditions set out in NPPF under which, following the application of the Sequential Test, it may be considered appropriate to allocate or permit development in areas at greater risk of flooding. For the Exception Test to be passed <i>“it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk; and a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall”</i> .
Flood Defence	Infrastructure such as floodwalls and embankments used to protect land from flooding. Flood defences are normally designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
FRA	Flood risk assessment. Site-specific assessment of flood risk to, and arising as a result of, a proposed development, prepared to accompany a planning application or in support of a specific development proposal. A site-specific FRA is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.
Fluvial Flooding	Flooding from a river or a watercourse.
Flood Zone 1	This zone comprises of land assessed as having a less than 1 in 1000 annual exceedance probability of river or sea flooding in any year (0.1% AEP).
Flood Zone 2	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual exceedance probability of river flooding (1% - 0.1% AEP) or between a 1 in 200 and a 1 in 1000 annual exceedance probability of sea (tidal) flooding (0.5% - 0.1% AEP) in any year.

TERM	DEFINITION
Flood Zone 3a	This zone comprises land assessed as having a 1 in 100 or greater annual exceedance probability of river flooding (>1% AEP) or a 1 in 200 or greater annual exceedance probability of flooding from the sea (>0.5% AEP) in any year.
Flood Zone 3b – Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local Planning Authorities should identify in their SFRA areas of Functional Floodplain and its boundaries accordingly, in agreement within the Environment Agency. The identification of Functional Floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual exceedance probability of 1 in 20 (5% AEP) or greater in any year, or is designed to flood in an extreme (0.1% AEP) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.
IDB	Internal Drainage Board.
ISIS	1D hydraulic modelling software package.
LLFA	Lead Local Flood Authority. As defined by the Flood and Water Management Act, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area, in this case Solihull Metropolitan Borough Council.
LiDAR	Light Detection and Ranging. Aerial survey technique which uses laser reflection timings to define ground levels, typical stated vertical accuracy is +/-150mm.
LPA	Local Planning Authority. Body that is responsible for controlling planning and development through the planning system.
mAOD	Metres Above Ordnance Datum (Newlyn). The standard datum which topographic levels are quoted relative to throughout the study area.
Main River	All watercourses shown on the statutory Main River maps held by the Environment Agency and Defra, and can include any structure or appliance for controlling or regulating flow of water into, in or out of the channel. The Environment Agency has permissive powers to carry out works of maintenance and improvement on these rivers.
Mitigation Measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
NPPF	National Planning Policy Framework.
NVZ	Nitrate Vulnerable Zone
Ordinary Watercourse	All watercourses that are not designated Main River, and which are the responsibility of LLFAs or, where they exist, IDBs.
OSMM	Ordnance Survey Master Map. OS Master Map is highly detailed mapping including individual buildings, roads and areas of land according to land use categories. The data is presented in GIS as polygon and line data.
OS NGR	Ordnance Survey National Grid Reference. Co-ordinate system used to define location within the UK.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	The aim of the NPPF Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The Strategic Flood Risk Assessment will provide the basis for applying this test. A sequential approach should be used in areas known to be at risk from any form of flooding.
SFRA	Strategic Flood Risk Assessment. In accordance with the NPPF.
SuDS	Sustainable Drainage Systems. Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
SWMP	Surface Water Management Plan. A plan which outlines the preferred surface water management strategy in a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, small water courses and ditches that occurs as a result of heavy rainfall.
TUFLOW	TUFLOW is a modelling package for simulating depth averaged 2D free-surface flows and is in widespread use in the UK and elsewhere for 2D inundation modelling.

## 1 INTRODUCTION

### 1.1 Planning Context

- 1.1.1 Solihull Metropolitan Borough Council (SMBC) adopted the Local Plan on the 3rd December 2013. The Plan sets out how and where Solihull will develop in the future containing draft policies and proposals for development in the Borough up to 2028. The Plan strategy promotes economic and job growth and includes SMBC's preferred strategic sites for development across the Borough.
- 1.1.2 The National Planning Policy Framework<sup>1</sup> (NPPF) and accompanying Planning Practice Guidance for Flood Risk and Coastal Change<sup>2</sup> (PPG) emphasise the responsibility of Local Planning Authorities (LPAs) to ensure that flood risk is understood and managed effectively using a risk-based approach throughout all stages of the planning process. The NPPF requires LPAs to undertake Strategic Flood Risk Assessments (SFRAs) to support their Local Plan.
- 1.1.3 The NPPF was published in March 2012 and replaces Planning Policy Statement 25 (PPS25) Development and Flood Risk<sup>3</sup>. The NPPF PPG published as an on-line resource in 2014 now supersedes the NPPF Technical Guidance<sup>4</sup> (2012) and the PPS25 Practice Guidance<sup>5</sup>. Accordingly, this Level 2 SFRA has been prepared in accordance with the principles set out in the NPPF and latest supporting PPG.
- 1.1.4 The NPPF and supporting guidance require LPAs to use the findings of the SFRA, and those of other studies, to inform strategic land use planning including the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk prior to consideration of areas of greater risk.

### 1.2 SFRA Overview

- 1.2.1 The NPPF PPG recommends that SFRAs are completed in two consecutive stages:
- Level 1 SFRA, and
  - Level 2 SFRA.
- 1.2.2 The Level 1 SFRA for SMBC<sup>6</sup> (to PPS25) was completed in January 2008 and issued as a 'Living Draft'. The document provided a high level overview of the various flood risks to the Borough of Solihull; the outputs of which have helped the council prepare sustainable policies for the long term management of flood risk across the Borough.
- 1.2.3 It is the responsibility of SMBC to prepare fully robust Sequential and (if necessary) Exception Tests in order to support the future allocation of any site. The Level 1 SFRA provided an evidence base for the Council to use to apply the Sequential Test to all sites within the 'high' and 'medium' risk Flood Zones across the Borough. In June 2012 SMBC undertook a Sequential Test on the Draft Local Plan Emerging Sites and identified two sites significantly affected by Flood Zones 2 and 3, and therefore application of the Exception Test was required. These sites were:
- Conway Road, Cole Valley, and,
  - Aqueduct Road, Solihull Lodge.
- 1.2.4 A further site was identified as potentially being significantly affected by surface water flooding and as such, application of the Exception Test was also required; Griffin Lane, Dickens Heath.

<sup>1</sup> Department for Communities and Local Government. 2012. *National Planning Policy Framework*. Available at:

<https://www.gov.uk/government/publications/national-planning-policy-framework--3>.

<sup>2</sup> Department for Communities and Local Government. 2014. *Planning Practice Guidance for Flood Risk and Coastal Change*. Available at <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/>

<sup>3</sup> Department for Communities and Local Government. 2010. *Planning Policy Statement 25: Development and Flood Risk*, TSO: London.

<sup>4</sup> Department for Communities and Local Government. 2012. *Technical Guidance to the National Planning Policy Framework*. TSO: London. Available at: <https://www.gov.uk/government/publications/national-planning-policy-framework-technical-guidance>

<sup>5</sup> Department for Communities and Local Government. 2009. *Planning Policy Statement 25: Development and Flood Risk Practice Guide*. TSO: London. Available at:

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/7772/pps25guideupdate.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7772/pps25guideupdate.pdf)

<sup>6</sup> Halcrow Group Limited. January 2008. *Level 1 Strategic Flood Risk Assessment for Local Development Framework Volume 1 – FINAL*. Solihull Metropolitan Borough Council

1.2.5 However, the Griffin Lane at Dickens Heath site has since not been taken forward to a Level 2 assessment as this site was already subjected to a site specific detailed (Level 3) FRA as part of a Full planning application (ref. PA 2012/1275). Full permissions were granted at this site on the 20<sup>th</sup> May 2013.

1.2.6 Further sites were also identified as potentially needing to undergo the Exception Test if taken forward. SMBC subsequently concluded that five of these sites (see Section 1.5) were to be taken forward and as such should be assessed as part of a Level 2 SFRA to the satisfaction of the Environment Agency, before these sites can be allocated for development.

### 1.3 URS Commission

1.3.1 URS was commissioned by SMBC in August 2012 to undertake a Level 2 SFRA in accordance with the NPPF and accompanying PPG for five potential development sites within the Borough of Solihull to inform application of the Sequential Test and (if required) Exception Test.

1.3.2 Under the Flood and Water Management Act (FWMA), which gained Royal Assent in 2010, SMBC are now designated as a Lead Local Flood Authority (LLFA) and have a number of duties and responsibilities for the effective management of local flood risk across the Borough of Solihull (these duties are further explained in Section 5.2). This Level 2 SFRA has been prepared through consultation with SMBC, the Environment Agency and the Canal and River Trust (CRT).

### 1.4 Aims and Objectives of the Level 2 SFRA

1.4.1 The aim of this Level 2 SFRA is to provide information on flood risk for 5 strategic development sites which after application of the Sequential Test and consideration of wider sustainability objectives, SMBC may consider for development despite having a level of flood risk.

1.4.2 The purpose of this report is therefore to provide further detail regarding the nature of the flood risk within the study area, and to allow SMBC to apply the Exception Test, if required, in the future. This is particularly critical in circumstances where a particular site (or sites) is deemed to be critical to the delivery of wider strategic aims, e.g. town centre regeneration.

1.4.3 In order to achieve this, the following objectives have been identified:

- define and map the functional floodplain in locations where this is required, including undefended watercourses;
- map the distribution of flood risk across all Flood Zones from all sources of flooding with allowances for climate change;
- appraise the current location, condition, operating standard and level of protection offered by flood defence infrastructure and of the likely future flood management policy with regards to its maintenance and upgrade;
- appraise the probability and consequences of overtopping or failure of flood risk management infrastructure, including estimating the rate and onset of flooding and the velocity and depth of flooding with an appropriate allowance for climate change;
- identify appropriate policies and practices required to ensure development satisfies both elements of the Exception Test at the planning application stage;
- identify and map residual risk (i.e. the risk remaining after mitigation measures have been implemented);
- assess risks to other areas upstream and downstream of the areas of interest as a result of development;
- identify the location of Critical Drainage Areas (CDAs) and identification of the need for a Surface Water Management Plan (SWMP) or a series of area specific SWMPs;
- provide guidance on the preparation of Flood Risk Assessments (FRAs) for areas of varying risk across the Flood Zones to enable developers to adhere to flood risk policies. This guidance should include information about the use of Sustainable Drainage Systems (SuDS) techniques suitably applicable to the study area;

- provide meaningful recommendations to inform policy, development management and technical issues; and
- identify strategic flood alleviation measures for reducing flood risk.

1.4.4 This Level 2 SFRA is a ‘Living Document’ that should be updated and informed by emerging studies that have a material effect on the SFRA.

**1.5 Study Area Overview**

1.5.1 Solihull Metropolitan Borough covers approximately 180 km<sup>2</sup> and is situated between Birmingham and Coventry. A high demand for housing has resulted from the proximity to Birmingham and public transportation links to London. The study area of this Level 2 SFRA encompasses five sites within the areas of Dickens Heath, Solihull Lodge near Shirley, Fordbridge and Chelmsley Wood. Shirley is identified in the Local Plan as an area of social deprivation within the Borough. Chelmsley Wood is the main centre for North Solihull and an important centre for commercial activity. One of the main objectives of the SMBC Local Plan is to encourage investment into the deprived urban areas of Shirley, Fordbridge and Chelmsley Wood.

1.5.2 The Borough is located within an upland catchment of the River Trent and River Severn (via the River Avon). As shown overleaf in Figure 1-1 key Main Rivers within Solihull include the following:

- |                    |                         |
|--------------------|-------------------------|
| • Mount Brook,     | • Hollywell Brook,      |
| • Alder Brook,     | • Westley Brook,        |
| • Ravenshaw Brook, | • Hatchford Brook,      |
| • Purnells Brook,  | • Low Brook,            |
| • River Blythe,    | • Kingshurst Brook, and |
| • Shadow Brook,    | • River Cole.           |

1.5.3 There are also two canals that flow through Solihull; the Grand Union Canal that runs through the centre of Solihull, and the Stratford-upon-Avon Canal which crosses the south-western corner of the Borough.

1.5.4 The Ordnance Survey (OS) Panorama Open Data set was reviewed to obtain information pertaining to the general topography of the Borough. Figure 1-1 identifies that the land generally slopes northwards and elevations range from between approximately 180 mAOD (metres Above Ordnance Datum) in the eastern area of Solihull down to 80 mAOD in the northern area of the Borough.

**1.6 Development Sites**

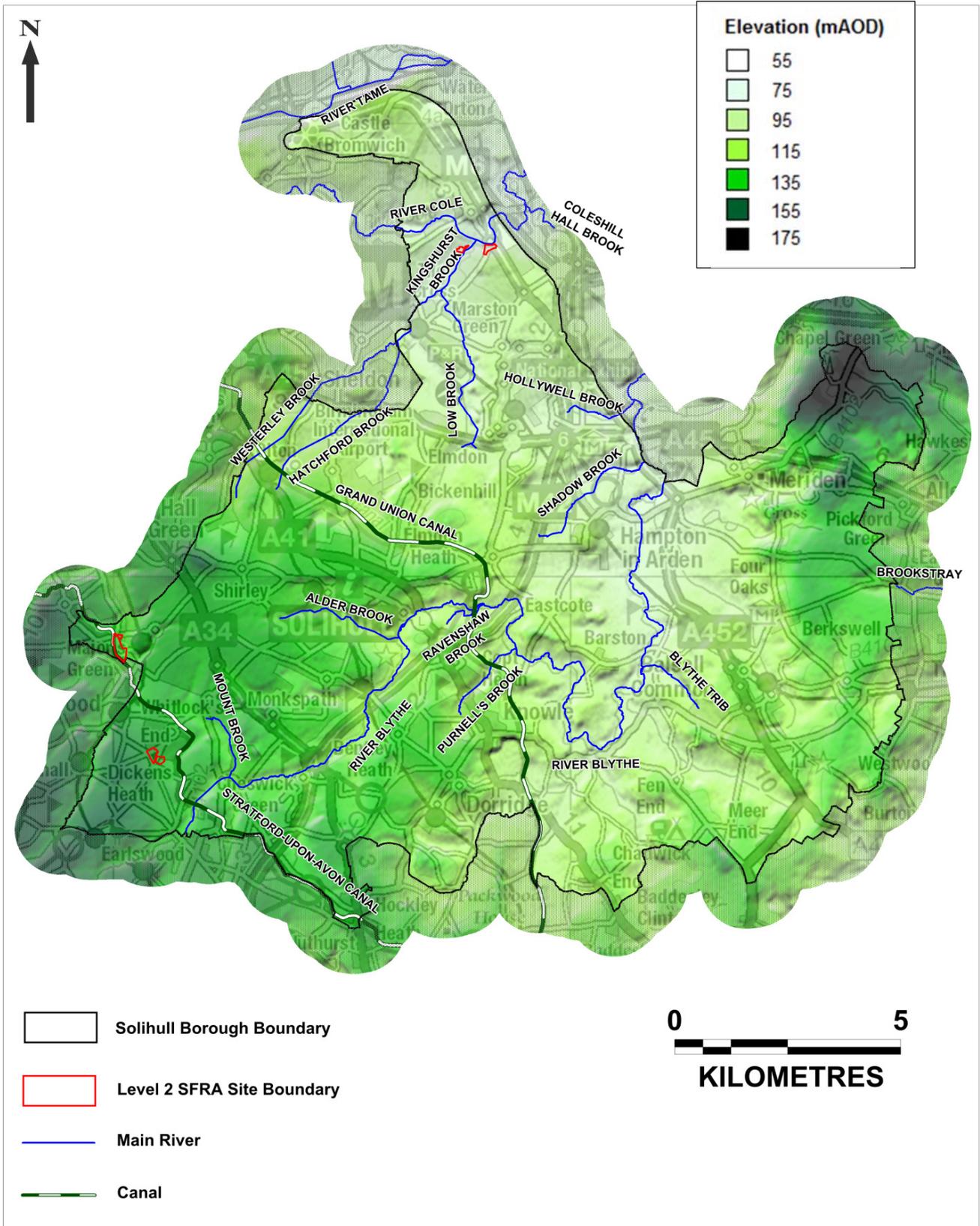
1.6.1 Following the outcomes of the Level 1 SFRA, five proposed strategic development sites identified as being potentially at risk of fluvial and/or surface water flooding were brought forward by SMBC for more detailed (Level 2) assessments to determine their suitability for development. The selected sites are detailed in Table 1-1 and displayed in Figure 1-2.

**Table 1-1: Strategic Allocation Sites within Solihull**

LOCAL PLAN REF.	SITE NAME	TOWN	AREA (HA)	SECTION 4 TABLE NO.
Site 2 - North Solihull Regeneration Area	Conway Road	Fordbridge	1.65	Table 4-1
Site 4 - North Solihull Regeneration Area	Bishop Wilson School and St Andrew's Scout Hut, Pike Drive	Chelmsley Wood	3.1	Table 4-2
Site 15 - Mature Suburbs	Aqueduct Road	Solihull Lodge	10.3	Table 4-3
Site 17 - Rural Area	Land at Braggs Farm / Bricklin Farm	Dickens Heath	2.6	Table 4-4
Site 20 - Rural Area	Land at Cleobury Lane	Dickens Heath	4.4	Table 4-5

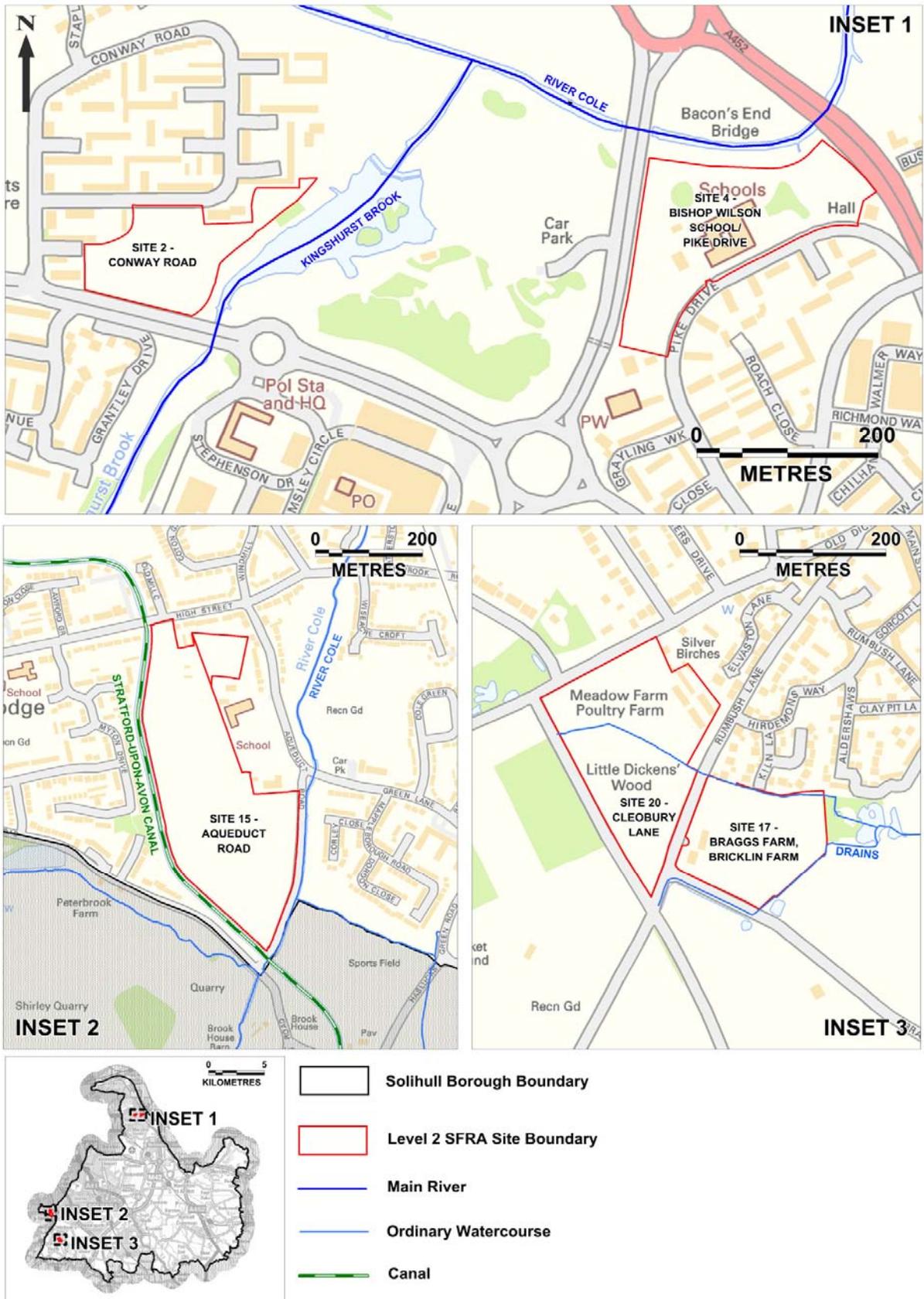
## 1.7 Approach

- 1.7.1 The conventional approach to identifying flood mechanisms and suitable mitigation options is based on the Source-Pathway-Receptor (SPR) model. The SPR model firstly identifies the causes or 'sources' of flooding based on a review of local conditions and consideration of the effects of climate change. The presence of a flood source does not always infer a risk. It is the flooding 'pathway' or mechanism that determines the risk to the receptor. For example, surface water (pluvial) or water surcharged from sewers (pluvial) or out of bank (fluvial) flooding does not necessarily present a risk unless ground levels encourage overland flows to accumulate and result in ponding.
- 1.7.2 The varying effect and significance of flooding on the 'receptors' and the consequence of being flooded depends largely on the sensitivity of the target. Receptors include any people or property within the range of the flood source, which are connected to the source of flooding by a pathway. In order for there to be a flood risk, all the elements of the model (i.e. a flood source, pathway and receptor) must be present.
- 1.7.3 Effective mitigation of the flood risk can be provided by removing one element of the SPR model.



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**Figure 1-1: Key Hydrological Features and Topography – Solihull**



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**Figure 1-2: Location Plan of Level 2 SFRA Sites in Solihull**

**2 SEQUENTIAL APPROACH TO SITE ALLOCATION**

**2.1 Flood Zone Definition**

2.1.1 The NPPF classifies land according to the probability of flooding from fluvial and tidal sources. The definitions for each Flood Zone with respect to fluvial flooding, are shown in Table 2-1.

**Table 2-1: Fluvial Flood Zones**  
(extracted from Table 1 the NPPF PPG 2014)

FLOOD ZONE	FLUVIAL FLOOD ZONE DEFINITION	PROBABILITY OF FLOODING				
<b>Flood Zone 1</b>	Land having a less than 1 in 1000 annual exceedance probability of river or sea flooding (<0.1% AEP) (all land outside Flood Zones 2 and 3)	<b>Low</b>				
<b>Flood Zone 2</b>	Land having between a 1 in 100 and 1 in 1000 annual exceedance probability of river flooding (>=1% to >=0.1% AEP); OR Land having between a 1 in 200 and 1 in 1000 annual exceedance probability of sea flooding (>=0.5% to >=0.1% AEP).	<b>Medium</b>				
<b>Flood Zone 3</b>	Land having a 1 in 100 or greater annual exceedance probability of river flooding (>=1% AEP); OR Land having a 1 in 200 or greater annual exceedance probability of sea flooding (>=0.5% AEP). Also known as Flood Zone 3a.	<b>High</b>				
<b>Flood Zone 3b</b>	<p>Land where water has to flow or be stored in times of flood, or land purposely designed to be flooded in an extreme flood event. The 1 in 20 annual exceedance probability event (5% AEP) floodplain is the starting point for consideration.</p> <table border="1" style="width: 100%;"> <tr> <td style="text-align: left;"><b>URS Position Statement</b></td> <td style="text-align: right;"><b>December 2014</b></td> </tr> <tr> <td colspan="2"> <p>Due to the limited extent of detailed modelling of the 5% AEP event in the Borough, it has been agreed between SMBC and the Environment Agency that Flood Zone 3 (&gt;=1% AEP) be used a proxy alternative for Flood Zone 3b for the purposes of the sites included within this Level 2 SFRA.</p> <p>Where development pressure creates the need to build in Flood Zone 3a, detailed modelling undertaken as part of a detailed FRA would be required to refine the definition of Flood Zone 3b, and if appropriate, a challenge to the Environment Agency Flood Map would need to be made.</p> </td> </tr> </table>	<b>URS Position Statement</b>	<b>December 2014</b>	<p>Due to the limited extent of detailed modelling of the 5% AEP event in the Borough, it has been agreed between SMBC and the Environment Agency that Flood Zone 3 (&gt;=1% AEP) be used a proxy alternative for Flood Zone 3b for the purposes of the sites included within this Level 2 SFRA.</p> <p>Where development pressure creates the need to build in Flood Zone 3a, detailed modelling undertaken as part of a detailed FRA would be required to refine the definition of Flood Zone 3b, and if appropriate, a challenge to the Environment Agency Flood Map would need to be made.</p>		<b>Functional Floodplain</b>
<b>URS Position Statement</b>	<b>December 2014</b>					
<p>Due to the limited extent of detailed modelling of the 5% AEP event in the Borough, it has been agreed between SMBC and the Environment Agency that Flood Zone 3 (&gt;=1% AEP) be used a proxy alternative for Flood Zone 3b for the purposes of the sites included within this Level 2 SFRA.</p> <p>Where development pressure creates the need to build in Flood Zone 3a, detailed modelling undertaken as part of a detailed FRA would be required to refine the definition of Flood Zone 3b, and if appropriate, a challenge to the Environment Agency Flood Map would need to be made.</p>						

**2.2 Development Vulnerability**

2.2.1 In order to determine the suitability of land for development in flood risk areas, the vulnerability of the proposed development must first be established. Flood risk vulnerability classifications, as defined in the NPPF PPG are summarised in Table 2-2.

**Table 2-2: Flood Risk Vulnerability Classification (extracted from Table 2 of the NPPF PPG 2014)**

VULNERABILITY CLASSIFICATION	DEVELOPMENT USES
Essential Infrastructure	<ul style="list-style-type: none"> <li>• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.</li> <li>• Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood.</li> <li>• Wind turbines.</li> </ul>
Highly Vulnerable	<ul style="list-style-type: none"> <li>• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding.</li> <li>• Emergency dispersal points.</li> <li>• Basement dwellings.</li> <li>• Caravans, mobile homes and park homes intended for permanent residential use.</li> <li>• Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).</li> </ul>
More Vulnerable	<ul style="list-style-type: none"> <li>• Hospitals.</li> <li>• Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels.</li> <li>• Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.</li> <li>• Non-residential uses for health services, nurseries and educational establishments.</li> <li>• Landfill and sites used for waste management facilities for hazardous waste.</li> <li>• Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.</li> </ul>
Less Vulnerable	<ul style="list-style-type: none"> <li>• Police, ambulance and fire stations which are not required to be operational during flooding.</li> <li>• Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in “more vulnerable”, and assembly and leisure.</li> <li>• Land and buildings used for agriculture and forestry.</li> <li>• Waste treatment (except landfill and hazardous waste facilities).</li> <li>• Minerals working and processing (except for sand and gravel working).</li> <li>• Water treatment works which do not need to remain operational during times of flood.</li> <li>• Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).</li> </ul>
Water-Compatible Development	<ul style="list-style-type: none"> <li>• Flood control infrastructure.</li> <li>• Water transmission infrastructure and pumping stations.</li> <li>• Sewage transmission infrastructure and pumping stations.</li> <li>• Sand and gravel working.</li> <li>• Docks, marinas and wharves.</li> <li>• Navigation facilities.</li> <li>• MOD defence installations.</li> <li>• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.</li> <li>• Water-based recreation (excluding sleeping accommodation).</li> <li>• Lifeguard and coastguard stations.</li> <li>• Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.</li> <li>• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.</li> </ul>

## 2.3 Sequential Test

- 2.3.1 The aim of the Sequential Test is to steer development towards areas of lowest probability of flooding first, before allocating development within areas of higher flood risk. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. A sequential approach should be used in areas known to be at risk from any form of flooding informed by an SFRA. Only where there are no reasonable available alternative sites suitable for the development in areas of lower flood risk, should areas of greater flood risk be considered for development.
- 2.3.2 Clause 103 of the NPPF states that “when determining planning applications, LPAs should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific FRA following the Sequential Test, and if required the Exception Test, it can be demonstrated that:
- within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location, and
  - development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems.”
- 2.3.3 SMBC have utilised the information from within the Level 1 SFRA (January 2008) to apply the Sequential Test to potential development sites within the Borough and determined that five sites required further consideration as part of a Level 2 SFRA. The information supplied as part of this Level 2 SFRA should provide sufficient information to apply the Exception Test to the five investigated potential development sites.
- 2.3.4 For the purposes of effective flood risk planning, development types are classified according to vulnerability. The need to apply the Exception Test is determined based on the Flood Zone (Table 2-1) in which the proposed development is located and the development vulnerability (Table 2-2 and Table 2-3).

## 2.4 Exception Test

- 2.4.1 Clause 102 of the NPPF states that “if, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate.”
- 2.4.2 The purpose of the Exception Test is to demonstrate and to help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. Clause 102 of the NPPF also states that “*for the Exception Test to be passed:*
- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared, and
  - A site-specific FRA must demonstrate that the development will be safe for its lifetime considering climate change, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.”
- 2.4.3 This Level 2 SFRA provides some information relating to the second part of the Exception Test for the five sites of interest. However, in all cases developers will need to undertake a site-specific FRA for each individual development site, in order to fully address the requirements of the second element of the Exception Test. For development to be considered acceptable and permitted for allocation, both the Sequential Test and the Exception Test need to be passed. Table 2-3 identifies situations where the Exception Test would be required in order for development to be considered acceptable.

- 2.4.5 The NPPF PPG specifies that there are a number of ways a new development can be made safe:
- Avoiding flood risk by not developing in areas at risk from floods;
  - Substituting higher vulnerability land uses for lower vulnerability uses in higher flood risk locations and locating higher vulnerability uses in areas of lower risk on a strategic scale, or on a site basis;
  - Leaving space in developments for flood risk management infrastructure to be maintained and enhanced;
  - Providing adequate flood risk management infrastructure which will be maintained for the lifetime of the development; and
  - Mitigating the potential impacts of flooding through design and resilient construction.

2.4.6 Further information and guidance for providing safe development is provided in Section 8.

**2.5 Flood Risk Vulnerability and Flood Zone Compatibility**

2.5.1 Table 2-3 has been extracted from the NPPF PPG and provides a matrix of the flood risk vulnerability classifications that are permitted within each Flood Zone subject to the Sequential Test being applied and passed and where necessary the Exception Test being applied and passed.

**Table 2-3: Flood Risk Vulnerability and Flood Zone ‘Compatibility’  
(extracted from NPPF PPG 2014)**

FLOOD ZONE	FLOOD RISK VULNERABILITY CLASSIFICATION				
	ESSENTIAL INFRASTRUCTURE	HIGHLY VULNERABLE	MORE VULNERABLE	LESS VULNERABLE	WATER COMPATIBLE
1	✓	✓	✓	✓	✓
2	✓	Exception Test required	✓	✓	✓
3a †	Exception Test required †	x	Exception Test required	✓	✓
3b *	Exception Test required *	x	x	x	✓

**Notes to Table 2-3:**

- This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
- Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

**Key:**

✓ - Development is appropriate

x - Development should not be permitted

† - In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

\* - In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere.

***Flood Zone 1***

- 2.5.2 Table 2-3 identifies that all development uses are considered appropriate within Flood Zone 1. A site-specific FRA concentrating on surface water runoff will be required for any major development within Flood Zone 1 that exceeds 1 Ha, demonstrating that surface water runoff will be effectively managed with the application of SuDS and the risk of flooding from this source will not be increased elsewhere as a result of the development.
- 2.5.3 Table 2-3 identifies that development types classified as Water Compatible, Less Vulnerable, More Vulnerable and Essential Infrastructure are considered appropriate within Flood Zone 2 subject to the Sequential Test being applied and passed. Highly Vulnerable developments are only permitted subject to the Sequential and Exception Tests being applied and passed. All development proposals within this Flood Zone should be accompanied by a detailed site-specific FRA.

***Flood Zone 2***

- 2.5.4 Policy aims for Flood Zone 2 are such that developers and LPAs should seek opportunities to reduce the overall level of risk in the area through the layout and form of the development, and through appropriate application of SuDS. This is reinforced by SMBC's Local Plan Policy 11 that states that "*All new development shall incorporate SuDS, unless it is shown to be impractical to do so*" (see Section 5.4).
- 2.5.5 Table 2-3 identifies that development types classified as Water Compatible and Less Vulnerable are permitted within Flood Zone 3a subject to the Sequential Test being applied and passed. Highly Vulnerable land uses should not be permitted. More Vulnerable and Essential Infrastructure uses should only be permitted in this zone subject to the Sequential Test, sequential approach and Exception Test being applied and passed. Essential Infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. All development proposals in this zone should be accompanied by a detailed site-specific FRA.

***Flood Zone 3 (3a and 3b)***

- 2.5.6 All development proposals in this zone should be accompanied by a detailed site-specific FRA.
- 2.5.7 Policy aims within Flood Zone 3a are such that developers and LPAs should seek opportunities to:
- relocate existing development to land in zones with a lower probability of flooding;
  - reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques; and
  - create space for flooding to occur by restoring functional floodplain and flood flow paths and by identifying, allocating and safeguarding open space for flood storage and SuDS.
- 2.5.8 Table 2-3 identifies that development types classified as 'Water Compatible' are permitted within Flood Zone 3b subject to the Sequential Test being passed, and that 'Essential Infrastructure' is permitted within this zone subject to the Exception Test also being applied and passed.
- 2.5.9 Any permitted development within the adopted Flood Zone 3b extent should be designed and constructed to:
- remain operational and safe for users in times of flood,
  - result in no net loss of floodplain storage,
  - not impede water flows, and
  - not increase flood risk elsewhere.
- 2.5.10 Policy aims in Flood Zone 3b are such that developers and LPAs should seek opportunities to:
- reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of SuDS; and
  - relocate existing development to land with a lower probability of flooding.

### 3 METHODOLOGY

#### 3.1 Scope of the Level 2 SFRA

- 3.1.1 This Section describes the scope and methodology of the Level 2 SFRA agreed following discussions with SMBC and consultation with the Environment Agency which allow the objectives stated in Section 1.4 in accordance with the NPPF, to be achieved.
- 3.1.2 The agreed methodology for completion of this Level 2 SFRA has been based on the use of existing information wherever possible from a range of sources. The data / information gathered are listed in Section 3.3 below.
- 3.1.3 Level 2 assessments have been undertaken in Section 4 of this report for sites shown in Table 1-1 to determine the flood risk issues, and residual flood risks relative to the following sources of flooding and with regard to the vulnerability classification of the proposed land uses at the sites:
- Sea (tidal),
  - Rivers (fluvial),
  - Surface water runoff from land (pluvial),
  - Sewers (pluvial),
  - Groundwater, and
  - Other Artificial sources (reservoirs, canals and flood defence infrastructure).

#### 3.2 Stakeholder Consultation

- 3.2.1 In the preparation of this Level 2 SFRA the following stakeholders were contacted to provide data, advice and information with regards to flooding:
- SMBC,
  - Environment Agency (Staffordshire, Warwickshire and West Midlands Region),
  - Severn Trent Water Ltd (ST), and
  - CRT.
- 3.2.2 The Environment Agency attended the project inception meeting with SMBC and URS to determine what information could be made available for the SFRA and to discuss how to best use the data. Correspondence letters detailing their recommendations for the approach to the assessment can be found in Appendix B

#### 3.3 Data / Information Collected

- 3.3.1 Information and GIS data received from the identified stakeholders can be summarised as the following:
- OS background mapping (1:10,000, 1:50,000 and 1, 250,000 scale);
  - OS Panorama data defining the topography (1:50,000 scale);
  - SMBC administrative boundary;
  - Locations and extents (red-line boundaries) of potential development sites and information relating to the proposed land use and scale,
  - Key hydrological features (e.g. Environment Agency Digital River Network inc. Main Rivers, CRT canals);
  - Environment Agency Flood Map (August 2014);
  - Environment Agency Areas Susceptible to Surface Water Flooding (AStSWF) map (April 2009);
  - Environment Agency Flood Map for Surface Water (FMfSW) (December 2010);

- Environment Agency Updated Flood Map for Surface Water (uFMfSW) (October 2013);
- Environment Agency Areas Susceptible to Groundwater Flooding (AStGWF) map (December 2010);
- Environment Agency Flood Warning and Flood Alert Areas (August 2014);
- National Flood and Coastal Defence Database (NFCDD) assets (August 2014);
- Locations and details of historical flood events;
  - Environment Agency Historical Flood Map (HFM) (August 2014),
  - CRT reported canal overtopping and breach incidents (April 2013),
  - ST DG5 Sewer Flooding Register (2002-2012),
  - Fire Service reported flood incidents,
  - Parish Council reported flood incidents.
- British Geological Survey (BGS) 1:50,000 scale bedrock and superficial data;
- Environment Agency Groundwater Source Protection Zones (SPZ) map, Groundwater Vulnerability maps and Aquifer Designation maps (August 2012);
- Environment Agency River Trent and River Severn Catchment Flood Management Plans (CFMP);
- Hydraulic modelling report and mapped model output from the Chelmsley Wood Hydraulic Modelling study (2011)<sup>7</sup> pertaining to the proposed strategic development of Site 2 (Conway Road, Fordbridge) and Site 4 (Pike Drive, Chelmsley Wood); and
- Solihull Preliminary Flood Risk Assessment (PFRA) (May 2011)
- Solihull Level 1 Strategic Flood Risk Assessment for Local Development Framework Volume 1 – FINAL (January 2008).
- Solihull Strategic Housing Land Availability Assessment (SHLAA) (September 2012) report.

3.3.2 All data was registered in the project data register and its accuracy and relevance reviewed to assess confidence levels for contribution to the SFRA.

**3.4 Data Presentation – GIS Layers**

3.4.1 Using the GIS layers provided, six site overview maps were produced as shown in Table 3-1 to visually assist SMBC in their site allocation decision making process.

**Table 3-1: Level 2 SFRA Mapping Contents**

CONTENTS	APPENDIX FIGURES
Environment Agency Flood Zones (Undefended) (Fluvial)	A-1
Environment Agency uFMfSW (Pluvial) Risk Classifications	A-2
Environment Agency AStGWF (Groundwater)	A-3
Environment Agency Flood Warning Areas and Flood Alert Areas	A-4
Reported Historic Flooding Incidents	A-5A
ST Reported Historic Sewer Flooding Incidents	A-5B

<sup>7</sup> JBA Consulting, July 2011. Chelmsley Wood Hydraulic Modelling Report – Draft Report.

### 3.5 Historical Flooding Records

3.5.1 Notable flooding events are noted in the Solihull PFRA (see Section 5.4) from Low Brook, the River Blythe and the River Cole, in particular the November 2007 event. Point locations of historical flooding incidents reported to SMBC, local Parish Councils and the Fire Service were provided as a GIS layer detailing their location and where data was available, the source of the flooding. These included fluvial events. These records in the vicinity of the Level 2 SFRA sites have been mapped (see Appendix A, Figure A-5A). The Environment Agency's latest Historical Flood Map (HFM) (August 2014) was also obtained for use in this study, however this illustrated no incidents in the vicinity of the Level 2 SFRA sites of interest.

### 3.6 Review of All Sources of Flooding

3.6.1 The allocation of future urban development and flood defences within a catchment can heavily influence flood risk in the area, and has the potential to further increase flood risk at areas downstream of such developments. Impacts include the lowering of the standard of protection (SoP) offered by flood defences and exceeding the capacity of culverts, drains, sewers and watercourse channels. This potentially leads to new areas being at risk of flooding that were previously not at risk, and highlights the increasing conflict and pressures emerging between climate change scenarios and future development aspirations.

3.6.2 In line with the approach detailed in Section 1.7, consideration has been given of the impacts of the proposed development on the flooding mechanisms associated with all potential sources of flooding.

#### *Sea (Tidal)*

3.6.3 Tidal flooding occurs following inundation of low lying land by sea water, and may result from a combination of factors. These include greater storm intensities increasing tide/wave amplitude, and Eustatic sea level rise in response to major climatic change/global warming (expansion of the oceans, melting glaciers, and melting icecaps).

3.6.4 Solihull lies approximately 80+ mAOD and therefore, tidal inundation is not considered to present a risk of flooding to the Level 2 SFRA strategic development sites and does not require further consideration for the purposes of this report.

#### *Rivers (Fluvial)*

3.6.5 Flooding from rivers can occur as a result of overtopping as channel capacities become exceeded, or due to surcharging as a result of a blockage or collapse of a structure such as a bridge or culverted sections. Figure 1-2 illustrates the routes of the designated Main Rivers and ordinary watercourses that may potentially pose a risk of flooding to the Level 2 SFRA study area sites.

3.6.6 The following watercourses provide potential sources of flood risk to the strategic site allocations being assessed as part of Level 2 SFRA:

- the River Cole (Main River) flowing in an easterly direction to the north of Sites 2 and 4;
- Kingshurst Brook (Main River) flowing in a north-easterly direction to the east of Site 2; and
- the River Cole (ordinary watercourse) flowing in a north-easterly direction alongside the eastern boundary of Site 15.

3.6.7 The Environment Agency's latest Flood Map (August 2014) provided for the purposes of this report (see Appendix A, Figure A-1 and available on their website<sup>8</sup>) illustrates predictive flood outlines derived through a mixture of detailed numerical hydraulic modelling techniques (where available), and national broad-scale (more coarse) modelling techniques where detailed modelling has not yet been undertaken.

3.6.8 These Flood Maps define the extent of flooding ignoring the presence of defences (undefended) as their presence cannot always be assured. The reason for this approach is to make an allowance for

<sup>8</sup> Environment Agency. 2014. 'Flood Map for Planning (Rivers and the Sea)'. Available at <http://maps.environment-agency.gov.uk>

residual flood risk in the event of a failure or breach/overtopping of the flood defences. This conservative approach over time will reduce reliance on flood defences and raises the awareness of flood risk in defended areas to help ensure that it is managed appropriately as part of development proposals. The Environment Agency updates their Flood Map on a quarterly basis to include the results of new flood mapping studies undertaken to improve and refine the Flood Zones.

3.6.9 The Flood Map however does not present Flood Zones associated with watercourses where their catchment areas are less than 3 km<sup>2</sup>. These include the following two ordinary watercourses that present potential sources of flood risk to the Level 2 SFRA sites (see Figure 1-2):

- An unnamed ordinary watercourse flowing in a south-easterly direction through the centre of Site 20 (Cleobury Lane) site, and bordering the northern edge of Site 17 (Braggs Farm); and
- An unnamed ordinary watercourse bordering the southern and eastern boundaries of Site 17 (Braggs Farm).

3.6.10 The fluvial flood risk from these sources is yet to be determined, and a detailed hydraulic modelling study will therefore be required as part of an FRA in support of any planning application to define the Flood Zones associated with these.

**Additional Detailed Modelling**

3.6.11 A hydraulic modelling report was completed in July 2011 which included analysis of the flood risk posed by the reaches of the River Cole and Kingshurst Brook in the vicinity of Site 2 (Conwey Road) in Fordbridge and by the River Cole in the vicinity of Site 4 (Pike Drive) in Chelmsley Wood. The report describes how the Environment Agency’s 1 dimensional (1D) (ISIS-only) hydraulic model (2006) developed as part of their Strategic Flood Risk Mapping (SFRM) framework was firstly extended to include representation of its tributary, Kingshurst Brook. It was also upgraded to a coupled ISIS-TUFLOW (1D-2D) model in the vicinity to provide refined representation of the floodplain overland flow routing.

3.6.12 The upgraded model was used to simulate the 1 in 20 year (5% AEP), 1 in 100 (1% AEP), 1 in 100 year plus an allowance for climate change (1% AEP +CC) and 1 in 1000 year (0.1% AEP) fluvial flood events in the vicinity. The extents of Flood Zones 2 and 3 were subsequently reduced. Figures C-1 and C-2 at Appendix C illustrate the revised modelled outlines produced for the different events and are discussed in Table 4-1 and Table 4-2.

3.6.13 For information regarding assumptions and limitations of the methodology adopted to generate these outlines please contact Environment Agency or refer to the Chelmsley Wood Hydraulic Modelling report (July 2011).

<b>URS Position Statement</b>	<b>December 2014</b>
<p>The Environment Agency confirmed in November 2014 that their Flood Map is soon to be updated to include the now approved output from the Chelmsley Wood Hydraulic Modelling study following a challenge made (correspondence can be found in Appendix B).</p> <p>The latest December 2014 publication of the Flood Map does not yet include such revisions to the Flood Zones. Therefore, for the purposes of this study, the current Flood Zones illustrated in Appendix A Figure A-1 are currently most the appropriate publically available dataset for comparison with Site 2 and Site 4.</p> <p>However, prior to any new planning application submitted for the site, it is recommended that the Environment Agency are contacted as part of a site specific FRA to request the most up to date information for comparison against these sites, as the July 2011 study demonstrated a significant reduction in fluvial flood risk at the site than presented in the Flood Map.</p>	

*Surface Water from Land (Pluvial)*

- 3.6.14 During periods of prolonged rainfall events and sudden intense downpours, overland flow generated from adjacent higher ground may flow across land and 'pond' in low-lying areas without draining into watercourses, surface water drainage systems or the ground. Intense rainfall that is unable to infiltrate into the ground or enter drainage systems can quickly run overland and result in local flooding.
- 3.6.15 One of the main issues with pluvial flooding is that relatively small changes to hard surfacing and surface gradients can cause flooding (garden loss and reuse of brownfield sites for example). This type of flooding is frequently experienced and often very destructive and it is possibly a more serious problem than suggested by historic records. Surface water flooding does not need a watercourse in close proximity to occur and is exacerbated by areas of highly impermeable hard standing such as tarmac, or low permeability soils and geology (such as clayey soils).
- 3.6.16 Following the Pitt Review<sup>14</sup> it was recommended that the Environment Agency identified areas within the nation that are at greatest risk from surface water flooding. The Environment Agency has since produced a national assessment of surface water flood risk in the form of two national mapping datasets that indicate broad areas likely to be at risk of surface water flooding. Their initial aim was to inform emergency planning procedures but this has since been broadened so that they can be used in conjunction with other information as part of SFRA.
- 3.6.17 The first generation Areas Susceptible to Surface Water Flooding (AStSWF) maps and second generation Flood Maps for Surface Water (FMfSW) covering Solihull were provided to SMBC as GIS layers by the Environment Agency in 2012 for use in this Level 2 SFRA.
- 3.6.18 However the Environment Agency has more recently undertaken further modelling of surface water flood risk at a national scale (October 2013) producing maps referred to as the updated Flood Map for Surface Water (uFMfSW) identifying areas at risk during three annual exceedance probability (AEP) events:
- 1 in 30 year ( $\geq 3.33\%$  AEP) – High Risk,
  - 1 in 100 year ( $\geq 1\%$  AEP) – Medium Risk, and
  - 1 in 1000 year ( $\geq 0.1\%$  AEP) – Low Risk.
- 3.6.19 These now provide the Environment Agency, SMBC (as the LLFA) and the public access to information on surface water flood risk that is consistent across England and Wales.
- 3.6.20 There are known limitations to the AStSWF, FMfSW and uFMfSW datasets. Due to the simplistic modelling techniques used in deriving the maps, they are not suitable for identifying whether an individual property will flood. In locations where surface water flooding is strongly influenced by topography, the maps may be suitable for identifying where properties are located in areas at risk of flooding which may justify further investigation through a site-specific FRA.
- 3.6.21 The uFMfSW modelling methodology represents a significant improvement on previous mapping, (namely the FMfSW and the AStSWF), for example:
- Increased model resolution to a 2 m grid providing a more detailed representation of ground levels;
  - Representation of varying infiltration rates taking into account the land use and soil type;
  - Representation of buildings and flow routes along roads, and manual editing of the model terrain to include structural floodplain features such as subways, flyovers, embankments etc.;
  - Use of 3 storm scenarios;
  - Incorporation of appropriate local mapping, knowledge and flood incident records; and
  - Local validation by LLFAs where flood records were available.

- 3.6.22 As such, they are considered the most appropriate dataset available to inform the assessment of surface water flood risk at the five strategic sites as part of this Level 2 SFRA to assist SMBC in their duties relating to management of surface water flood risk.
- 3.6.23 However, it should be noted that this national mapping has the following limitations:
- Use of a single rainfall event, and a single drainage rate for all urban areas;
  - It does not show the susceptibility of individual properties to surface water flooding (varying thresholds);
  - The mapping has significant limitations for use in flat catchments;
  - No explicit modelling of the interaction between the surface water network, the sewer systems, large subsurface drainage elements and watercourses (such as flood relief culverts and flood storage and it does not include representation of canals);
  - In a number of areas, modelling has not been validated due to a lack of surface water flood records; and
  - As with all models, the uFMfSW is affected by a lack of, or inaccuracies in available data.
- 3.6.24 The uFMfSW for Solihull were provided to SMBC as GIS layers by the Environment Agency for use in this Level 2 SFRA in 2014 and are presented in Appendix A, Figure A-2. A GIS layer of historical flooding incidents including incidents of surface water flooding provided by SMBC is presented in Appendix A, Figure A-5A. These are currently also known as the 'Risk of Flooding from Surface Water' maps presented on the Environment Agency's website<sup>9</sup>.
- 3.6.25 The Solihull PFRA states that there have been multiple records of surface water flooding spread throughout the Borough, but have concentrated towards the west. These have been attributed to overtopping of drainage ditches, overland flows, and surcharging of the sewerage system and made a notable contribution to the significant fluvial events of November 2007. There have however been no records of surface water flooding with significant harmful consequences.
- 3.6.26 A further data review is made in Section 6 of this report, and guidance is provided regarding assessing the flood risk posed by surface water generated by any future development within the Level 2 SFRA sites. Site specific modelling will be required as part of an FRA.

### ***Sewers (Pluvial)***

- 3.6.27 Sewer flooding generally results in localised short term flooding caused by intense rainfall events overloading the capacity of sewers. Flooding can also occur as a result of blockage, poor maintenance or structural failure of sewers resulting in surcharging at the surface.
- 3.6.28 The capacities and condition of historic sewer networks are often unknown. As towns and villages expand to accommodate growth, the original sewer systems are rarely upgraded, eventually becoming overloaded and reducing their efficiency. Compounding this problem are the effects of climate change. Climate change is forecast to result in milder and wetter winters and more thunderstorms in summer months. This combination will increase the pressure on existing sewer systems effectively reducing their capacity, leading to more frequent flooding.
- 3.6.29 More recently constructed sewers are designed according to guidelines to accommodate relatively frequent storm events although in many cases, it is thought that this design standard is not achieved, especially in privately owned systems. It is therefore likely that parts of the sewer system will surcharge during large, high intensity rainstorm events resulting in frequent flooding, particularly if the systems are combined and if climate change forecasts are correct. Due to the limited capacities and necessary design standards, the level of risk posed by and probability of sewer flooding is therefore greater/more frequent than that of fluvial flooding.
- 3.6.30 The Local Flood Risk Management Plan for the River Cole suggests that Combined Sewer Outfall's (CSO's) contribute heavily to the flows within the water courses in Solihull. Areas affected by sewer flooding have been identified using historical data provided by ST DG5 sewer flooding register. All water companies are obliged to keep such a register of those properties that have been affected

<sup>9</sup> Environment Agency. 2014. 'Risk of Flooding from Surface Water' map. Available at <http://maps.environment-agency.gov.uk>

both internally and externally by sewer flooding from either, foul, surface water or combined sewer networks.

- 3.6.31 This data provided illustrates the total number of sewer flooding incidents (internal and external) from public foul, combined or surface water sewers covering the period 1993-2013 (superseding those presented in Appendix A of the Level 1 SFRA) and is illustrated in the vicinity of the Level 2 SFRA site in Figure A-5B at Appendix A.
- 3.6.32 It is important to note that DG5 data is only an indicator of the location, cause and the extent of historical flood events (internal or external to properties). The register contains commercially sensitive information as well as information covered by the Data Protection Act (1998) and therefore, locations cannot be supplied at an individual property level.
- 3.6.33 The data provided by ST is further limited as it simply indicates areas reported to ST that have experienced flooding during the last 10 year period as a result of insufficient hydraulic capacity in the sewer network. It should be noted that the flood records provided could be misleading as they may not be a complete and accurate record of flood events in the study area over the 10 year period as some minor flooding incidents may go unreported, particularly if no property is affected by internal flooding.
- 3.6.34 It is important to note that maintenance work may have been undertaken by ST since the flooding incident(s) occurred. More detailed ST sewer flooding models provide a much more detailed and useful appreciation of the risk posed. However much of this work is not yet publicly available due to commercially sensitive issues or the Data Protection Act and so the limited data that has been provided is the best available information at present. More detailed information should be requested from ST for site specific FRAs.

#### *Groundwater*

- 3.6.35 Groundwater flooding occurs where groundwater levels rise above ground surface levels. Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks (aquifers), usually associated with chalk, sandstone and limestone catchments that allow groundwater to rise to the surface through permeable subsoil following long periods of wet weather. High water tables may result in standing water on low lying ground that is unable to reach a ditch or watercourse and is unable to percolate through the ground due to seasonally high water perched groundwater levels. Groundwater rebound may also occur as a result of the ceasing of groundwater abstraction by pumping following closure of industrial mining works.
- 3.6.36 A quantified assessment of risk from groundwater flooding is difficult to undertake, especially on a strategic scale. This is due to lack of groundwater level records, the variability in geological conditions and the lack of predictive tools (such as modelling) that can be used to make assessments of groundwater flow and risk of groundwater flooding following rainfall events.
- 3.6.37 Geological ground conditions in the region have been considered in establishing the level of risk associated with this flood source. The Environment Agency released a new dataset entitled Areas Susceptible to Groundwater Flooding (AStGWF) in March 2011. This data has used the top two susceptibility bands of the BGS 1:50,000 'Groundwater Flooding Susceptibility Map' and thus covers consolidated aquifers (sandstone etc., termed 'clearwater' in the data attributes) and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It also does not indicate the likelihood of groundwater flooding occurring. It shows the percentage of each 1 km grid square where geological and hydrogeological conditions illustrate a susceptibility to groundwater emergence. Absence of values for any grid square means that no part of that square is identified as being susceptible to groundwater emergence.
- 3.6.38 The susceptible areas are represented by one of four area categories (listed below) showing the percentage of each 1 km<sup>2</sup> that is susceptible to groundwater emergence.
- < 25% (Low to Medium susceptibility),
  - >= 25% <50% (Medium to High susceptibility),
  - >= 50% <75% (High to Very High susceptibility), and
  - >= 75% (Very High susceptibility).

- 3.6.39 The Environment Agency's AStGWF map for Solihull is presented in Figure A-3 in Appendix A.
- 3.6.40 In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding. The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding.<sup>10</sup>

#### ***Other Artificial Sources***

- 3.6.41 The NPPF states that the potential flood risks associated with artificial structures need to be considered as part of an SFRA. Level 2 SFRA's are required to appraise the current condition of such infrastructure and of likely future policy with regard to its maintenance and upgrade, where appropriate.
- 3.6.42 Man-made/artificial sources of flooding include canals and impounded reservoirs where water is retained above natural ground level, and operational and redundant industrial processes (including mining, quarrying and sand and gravel extraction), as they may result in an increase in floodwater depths and velocities in the event of failure, overtopping or breach. These sources are reviewed below.

#### **Canals**

- 3.6.43 The Stratford-upon-Avon Canal borders the eastern boundary of Site 15 (Aqueduct Road). The southern half of this reach comprises a raised embankment (see Inset 2 in Figure A-1 Appendix A) to facilitate the aqueduct crossing over the River Cole.
- 3.6.44 Canal flooding may occur as a result of their capacities being exceeded and/or as a result of raised embankment failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage.
- 3.6.45 Canal embankment failure has been known to happen occasionally but the impact is not considered to be as extensive as a failure of a reservoir dam as studies have shown that maximum discharges are limited to the volume held within the canal cross section between two locks. This residual risk is managed by the Canal and Rivers Trust (CRT) who perform monthly towpath side inspections and other inspections at no more than quarterly intervals.
- 3.6.46 Canals are considered to be controlled water bodies so flood risk is deemed to be minimal unless overtopped in storm conditions. There is, however, a residual risk of structural failure. The CRT is not a flood defence body, although they do manage some critical flood defence structures including flood gates.
- 3.6.47 Water control manuals are currently being prepared by the CRT across the country. The principal behind these is to record what actions have to be taken to control feeds and structures in both normal and what is considered by the CRT to be flood conditions.
- 3.6.48 In general, the canal system is hydraulically closed down at relatively low river levels prior to the issuing of a flood alert from the Environment Agency (see Section 8.8). This is to protect the canal corridors from slightly high river levels which would overtop the banks, and to protect craft from venturing onto rivers at dangerous flows. The system however is dependent on the levels of associated Environment Agency flood defences. Overtopping or breach of river defences into a canal corridor could result in transfer of flood waters to other vulnerable areas.
- 3.6.49 Canals generally work at relatively stable water levels with the various lock by-passes, and waste weirs passing and controlling excess feeds without leading to overtopping of the banks. The most likely cause of overtopping in canals is vandalism. Incorrect use of lock gate sluices can drain pounds upstream and overwhelm pounds downstream leading to loss of water over the banks, particularly if the weirs have also been blocked by rubbish.

<sup>10</sup> Environment Agency. 2011. *Areas Susceptible to Groundwater Flooding – Data Guidance and Usage*.

- 3.6.50 Guidance for LLFAs to produce their PFRAs (see Section 5.2) provided by Defra<sup>11</sup> advises that the presence of a canal should not in itself lead an LLFA to extend or identify a new Flood Risk Area, given the relatively low risk of flooding from canals. As LLFA, the decision therefore lies with SMBC as to the level of flood risk assessment required associated with a canal.
- 3.6.51 The Council presume as a principal that canals in their area are maintained effectively but will consider for each of them the effect of a catastrophic structural failure resulting in rapid inundation of protected areas. It is considered that overtopping of such structures during conditions more severe than for which they have been designed would not itself lead to rapid inundation.
- 3.6.52 Neither the PFRA nor Level 1 SFRA identified any historical flooding events along this reach of the Stratford-upon-Avon Canal adjacent to Site 15. The CRT also confirmed that they hold no records of breach or overtopping in the vicinity of the Level 2 SFRA proposed strategic development sites.

### **Impounding Reservoirs**

- 3.6.53 Reservoir flooding may occur as a result of the capacity of the facility being exceeded and/or as a result of dam or embankment failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage.
- 3.6.54 The 'Risk of Flooding from Reservoirs' map on the Environment Agency's website<sup>12</sup> illustrates the maximum potential extent of inundation from breach failure of any reservoirs subject to the Reservoirs Act 1975 modelled as part of the Reservoir Inundation Mapping (RIM) modelling project (2011). Reservoirs included within this modelling project included those characterised by  $\geq 25,000 \text{ m}^3$  of water impounded above the adjacent ground level.
- 3.6.55 The map illustrates that the Level 2 SFRA strategic proposed development sites are not at risk of inundation from breach failure of any reservoirs upstream of the site. It is therefore considered that the risk of flooding to the sites from these artificial sources is negligible.

## **3.7 Consideration of Climate Change**

- 3.7.1 The NPPF PPG references further Environment Agency guidance on consideration of climate change allowances for planners<sup>13</sup>. Table 2 of this guidance document recommends consideration of up to a 30% increase in the peak rainfall intensity and up to a 20% increase in peak flows in watercourses over the next 100 years. This will significantly increase the risk of flooding, by instigating more rapid runoff into watercourses, increased ponding of surface water, and surcharging of gullies, drains and sewers; particularly in steep, urbanised catchments.
- 3.7.2 The Trent Catchment Flood Management Plan (CFMP) also considered changes in flood risk over the next 50 to 100 years driven by climate change and changes in land use (i.e. increased urban development). Catchment models and the Modelling and Decision Support Framework (MDSF) software were used in the CFMP to test catchment sensitivity to these flood risk drivers across the study area. This testing demonstrated that sewer flooding and surface water flooding are likely to become more frequent and widespread under urbanisation and climate change scenarios, highlighting the importance of and requirement for SuDS implementation.
- 3.7.3 The NPPF sets out important guidance and objectives to meet the flooding challenges brought about by climate change. Consideration of this guidance should always be included as part of site specific FRAs for individual developments (detailed in Section 8), and it should usually be possible to mitigate against increased flood risk. Recommendations for specific measures considered pertinent to the Level 2 SFRA sites are provided in the site summary tables in Section 4.

## **3.8 Review of Existing Flood Risk Management Infrastructure**

- 3.8.1 The NPPF states that flood risk management infrastructure need to be considered as part of an SFRA. Level 2 SFRA sites are required to appraise the current condition of flood defence infrastructure and of likely future policy with regard to its maintenance and upgrade, where appropriate.

<sup>11</sup> Defra 2010. 'Selecting and reviewing Flood Risk Areas for local sources of flooding Guidance to Lead Local Flood Authorities'. Available at <http://archive.defra.gov.uk/environment/flooding/documents/research/flood-risk-method.pdf>

<sup>12</sup> Environment Agency. 2014. 'Risk of Flooding from Reservoirs' map. Available at <http://maps.environment-agency.gov.uk>

<sup>13</sup> Environment Agency. 2013. *Climate change allowances for planners - Guidance to support the National Planning Policy Framework*

3.8.2 Flooding may result from the failure of engineering installations such as raised flood defences (walls and earth embankments), land drainage pumping stations, sluice gates, floodgates and weirs. Hard defences may fail through the slow deterioration of structural components such as the rusting of sheet piling, erosion of concrete reinforcement and toe protection or the failure of ground anchors. Such deterioration is often difficult to detect, so that failure, when it occurs, is often sudden and unexpected. Failure is more likely when the structure is under maximum stress, such as extreme fluvial events when pressures on the structure are at its most extreme.

3.8.3 The Environment Agency NFCDD database identifies no areas currently protected by such defences within Solihull, and therefore no further assessment was required of such infrastructure.

### 3.9 Assessment of Residual Risk

3.9.1 Residual risks are those that remain even with flood mitigation measures in place. None of the proposed development areas are located behind defences and therefore, they are not at risk of flooding as a result of failure of any defences.

3.9.2 General policy advice has therefore been provided in each site summary table in relation to the consideration of residual risk of flooding to the proposed strategic development sites from other (non-fluvial) sources of flooding.

3.9.3 Detailed guidance is provided in Section 8 including emergency response (flood warning and emergency plans), access and egress and advice on appropriate finished flood levels.

### 3.10 SFRA Policies, Recommendations and Guidance for Developers

3.10.1 A series of policies and guidance for proposed development at each of the sites is provided in the site summary tables in Section 4. More detail is also provided in Section 5 to Section 8 including site specific FRA guidance and SuDS guidance to enable developers to consistently adhere to flood risk policies.

3.10.2 These policy statements are aimed at reducing the associated flood risk by making recommendations to:

- Adopt a site layout that adheres to the NPPF Sequential Test and Exception Test criteria,
- Roll back development away from the watercourse and incorporate green (or “blue”) corridors in the layout design, ensuring that no development encroaches within modelled Flood Zone 2 ( $\geq 0.1\%$  AEP event) or is restricted to a distance away from an un-modelled watercourse (as agreed with the LLFA and the Environment Agency);
- Consider the risk from all sources of flooding as part of a detailed site specific FRA, which may include modelling of a watercourse, should it currently be un-modelled;
- Determine suitable flood risk mitigation measures and management options where other strategic factors govern the need to develop within a flood risk area including:
  - Minimum floor levels,
  - Flood resilience/resistance,
  - Access and egress,
  - Emergency response e.g. flood warnings and evacuation plans, and
  - SuDS.
- Ensure that any proposed development will not have a detrimental effect upon flood risks posed to areas upstream or downstream of the proposed development site (SuDS).

### 3.11 SuDS Suitability Guidance

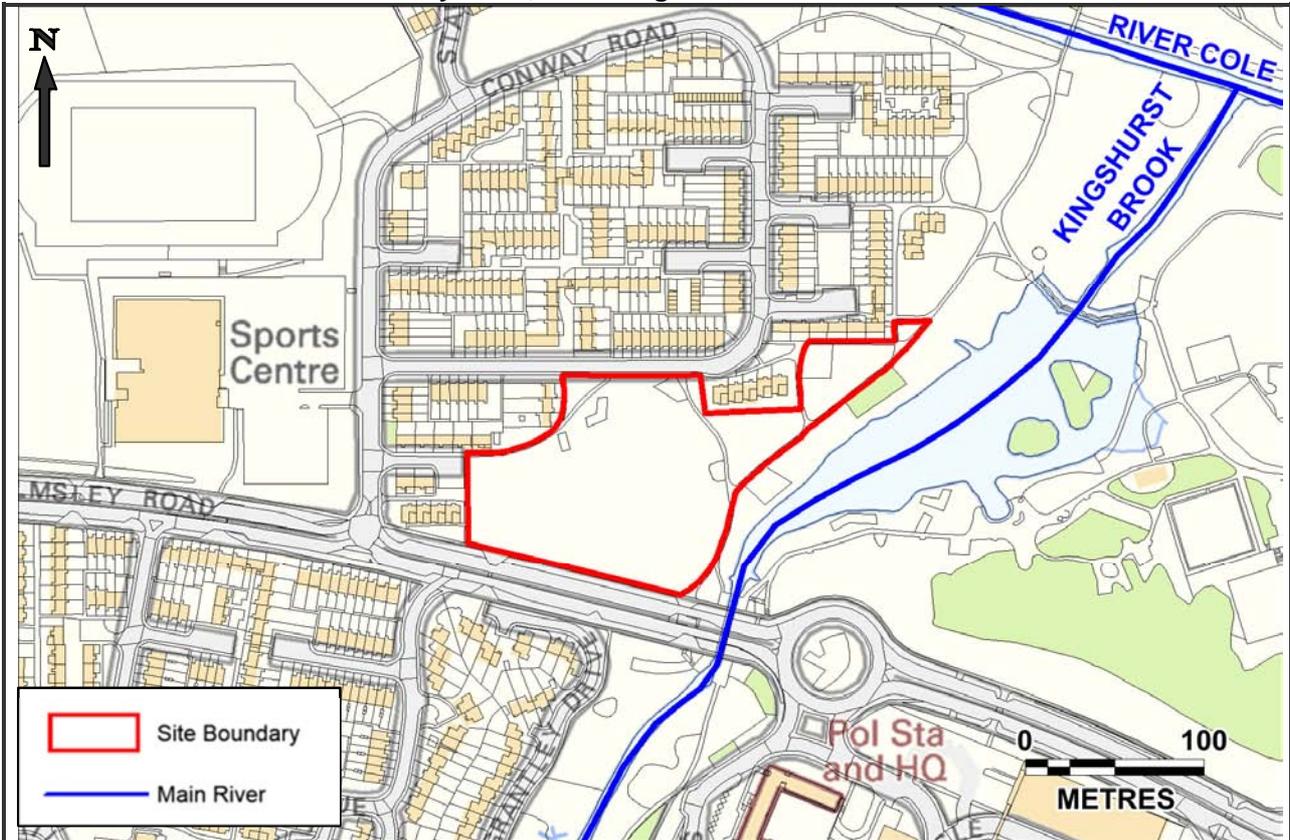
3.11.1 New obligations under Schedule 3 of the FWMA means that SMBC will have new responsibilities as a SuDS Approval Body (SAB) (refer to Section 5.2) once Schedule 3 is enacted. Until this time, or until any alternative arrangements are put in place by Government, it is prudent that all SuDS proposals be agreed and approved by SMBC as the LLFA prior to being implemented and adopted. Early discussions with the LLFA are essential to ensure a suitable approach is developed for any given site.

- 3.11.2 Guidance on the suitability of SuDS is required to help planners and developers make decisions regarding the use of SuDS techniques in developments at an early stage of the planning process. Locally specific guidance will enable developers to identify which SuDS techniques may be suitable and ensure that they are suitably accommodated in area layout and landscaping.
- 3.11.3 The National Guidance for SABs containing advice on SuDS, their suitability, implementation and adoption was due to be published in April 2014; however, as of the time of writing this report it has not yet been released. In the meantime SMBC are required to produce locally specific guidance anticipated to be published after the National Guidance for SABs. Guidance on SuDS techniques that may potentially be suitable are detailed in Section 8.7.

4 LEVEL 2 SITE ASSESSMENTS

4.1.1 This Section provides site summary tables including a review of each of the Level 2 SFRA sites against the data detailed in Section 3.

4.2 Table 4-1: Site 2 - Conway Road, Fordbridge



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**Figure 4-1: Site Location Plan – Site 2 Conway Road, Fordbridge**

Site Information	
Site Area	1.65 Ha
Existing Land Use and Topography	OS mapping (Figure 4-1) and aerial photography illustrate that the site is located between Conway Road and Chelmsley Road to east of Meriden Park. It encompasses areas of public open space and small areas of woodland and is therefore considered to be greenfield.  OS Panorama data illustrates that the site is relatively flat, gently sloping in a north-easterly direction from approximately 82 mAOD down to 80 mAOD.
Proposed Use and Vulnerability Classification	The site is identified as Site 2 in the adopted Local Plan, and southern extent of the Kingshurst and Fordbridge Site 188 in the Solihull SHLAA within the North Solihull Regeneration Area.  The adopted Local Plan identifies the site as having the capacity for a total of 75 residential dwellings. Under the NPPF, residential development is classified as 'more vulnerable' and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a provided the Exception Test is passed.

<b>Sources of Flood Risk</b>	
<b>Rivers</b>	<p>OS mapping (Figure 4-1) illustrates Kingshurst Brook (a Main River) flowing in a north-easterly direction along the eastern boundary of the site, and the River Cole (a Main River) flowing in an easterly approximately 170 m to the north of the site.</p> <p>As shown in Figure A-1 in Appendix A, the Environment Agency’s Flood Map (undefended) illustrates that Flood Zone 3 (<math>\geq 1\%</math> AEP of flooding) and Flood Zone 2 (<math>\geq 0.1\%</math> AEP of flooding) associated with Kingshurst Brook encompass the majority of the site. Smaller areas of the site in the north, the north-east corner and along the south-western boundary are shown to be located within Flood Zone 1 (<math>&lt; 0.1\%</math> AEP of flooding). As a result, the site is located within an Environment Agency Flood Alert area (see Section 8.8 and Appendix A, Figure A-4).</p> <p>However, the more detailed ISIS-TUFLOW 2D model produced as part of the Chelmsley Wood Hydraulic Modelling Study (2011) (Figure B-1, Appendix B) illustrates that the site falls entirely within Flood Zone 1.</p> <p>It is noted that the Environment Agency confirmed that their Flood Maps are to be updated accordingly as a result of a challenge made with these latest model results, but at the time of submission of this report, this has not yet occurred. Therefore, for the purposes of this study, the current Flood Zones illustrated in Appendix A Figure A-1 are the most appropriate dataset for comparison with Site 2.</p> <p>Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) identify no historical incidents of fluvial flooding have been recorded at the site</p>
<b>Surface Water</b>	<p>The Environment Agency’s uFmFSW (Figure A-2 in Appendix A) illustrates that the risk of flooding from surface water runoff from land is predominantly very low (<math>&lt; 0.1\%</math> AEP of flooding), however areas at low risk (<math>\geq 0.1\%</math> AEP of flooding) are illustrated across three routes proceeding southwards through the site along the lowest elevated ground. Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) illustrate no historical incidents of surface water flooding have been reported at the site or immediate vicinity.</p>
<b>Geology and Groundwater</b>	<p>BGS mapping (see Section 6.2) and the Environment Agency’s Aquifer Designation map (see Section 6.4) identifies that the entire site is underlain by a layer of Mercia Mudstone bedrock classified as a ‘Secondary B’ aquifer. Secondary B aquifers are predominantly less permeable layers and yield limited amounts of groundwater. The majority of site is overlain by a layer of alluvium superficial deposits consisting of clay, silt, sand and gravel designated as a ‘Secondary A’ aquifer. Secondary A aquifers are only capable of supporting water supplies at a local level, often being an important source of base flow to rivers.</p> <p>The Environment Agency’s AStGWF map (Figure A-3 in Appendix A) used to identify areas susceptible to groundwater emergence illustrates that the site lies within a 1 km grid square where between 25% and 50% of the area is considered to be susceptible to groundwater emergence.</p>
<b>Sewers</b>	<p>The ST DG5 register (Figure A-8 in Appendix A) identifies no recorded incidents of sewer flooding within the site or immediate vicinity between 1993 and 2013.</p>
<b>Artificial Sources</b>	<p>There are no canals or elevated/impounded reservoirs in the vicinity of the site. Therefore, no further assessment of these is required as part of this Level 2 SFRA.</p>
<b>Flood Defence Infrastructure</b>	
<p>The NFCDD identifies no existing raised flood defence infrastructure present along the reach of Kingshurst Brook or the River Cole within the local vicinity. No analysis of defences overtopping was therefore required.</p>	
<b>Residual Flood Risks</b>	
<p>As no raised flood defences are present, no defence breach failure analysis was required.</p> <p>The ‘Risk of Flooding from Reservoirs’ maps on the Environment Agency’s website illustrates no risk of inundation from breach failure of any reservoirs upstream of the site.</p> <p>Therefore, no further assessment of these is required as part of this Level 2 SFRA.</p>	

**Recommendations and Policies**

- As part of a site specific FRA it is recommended that the Environment Agency be consulted further to determine their current position on the further detailed/more refined modelling output for Kingshurst Brook defined as part of the Chelmsley Wood Hydraulic Modelling Study (2011).
- Where possible, development should be rolled back to outside the Environment Agency’s undefended Flood Zone 2 ( $\geq 0.1\%$  AEP of flooding) and Flood Zone 3 ( $\geq 1\%$  AEP of flooding) extents for Kingshurst Brook, to create a ‘blue corridor’ that provides reduced flood risk, wildlife habitat and public amenity areas. Any development subsequently proposed within Flood Zone 1 ( $< 0.1\%$  AEP of flooding) will be considered to pass the Sequential Test on the grounds of fluvial flood risk.
- If there remains a requirement to develop within the adopted Flood Zone 3 ( $< 1\%$  AEP of flooding) outline of Kingshurst Brook, then a detailed FRA will be required to demonstrate that the Exception Test can be passed through a review of the flood depths and hazard classifications within the defined extents to ensure it is safe. It is recommended that development does not encroach within a minimum of 8 m of the watercourse banks of Kingshurst Brook, which is the EA’s by-law distance for maintenance access along Main Rivers in the Staffordshire, Warwickshire and West Midlands Region. This would be beneficial in terms of flood risk, wildlife habitat and amenity potential.
- Surface water/pluvial flood risk should also inform any proposed site layout such that the most vulnerable parts of the proposed development are avoided in locations shown to be at the highest risk of pluvial flooding. Overland flow routes should be considered in the development design. Appropriate mitigation measures should be investigated and implemented to prevent this source of flooding from causing any detrimental impact to the development or surrounding land uses.
- As the area is primarily greenfield, any impermeable development within the area will increase surface water runoff (unless attenuated). A surface water management framework should be adopted as part of a masterplan to limit and, where possible, reduce surface water runoff rates and volumes from the developed site to greenfield runoff rates and volumes as required by the Environment Agency to prevent any resultant increase in flood risk posed downstream. NPPF states that SuDS should, where possible, mimic the natural drainage mechanism of an area. Infiltration is part of the natural drainage process. Environment Agency advice indicates a presumption in favour of infiltration SuDS techniques being used wherever possible.
- The review of the BGS data and Environment Agency Aquifer Designation maps suggest that infiltration SuDS may be feasible within the site and therefore infiltration techniques may be more appropriate as the groundwater is likely to support the base flow of Kingshurst Brook. Detailed site-specific analysis and ground investigation (GI) should be undertaken before the use of infiltration SuDS techniques is dismissed pending the outcome of any contamination assessment/remediation works. Any proposed SuDS scheme should aim to maximise benefits for biodiversity (e.g. ponds in preference to below ground storage), and manage the water quality of any discharge into the River Cole.

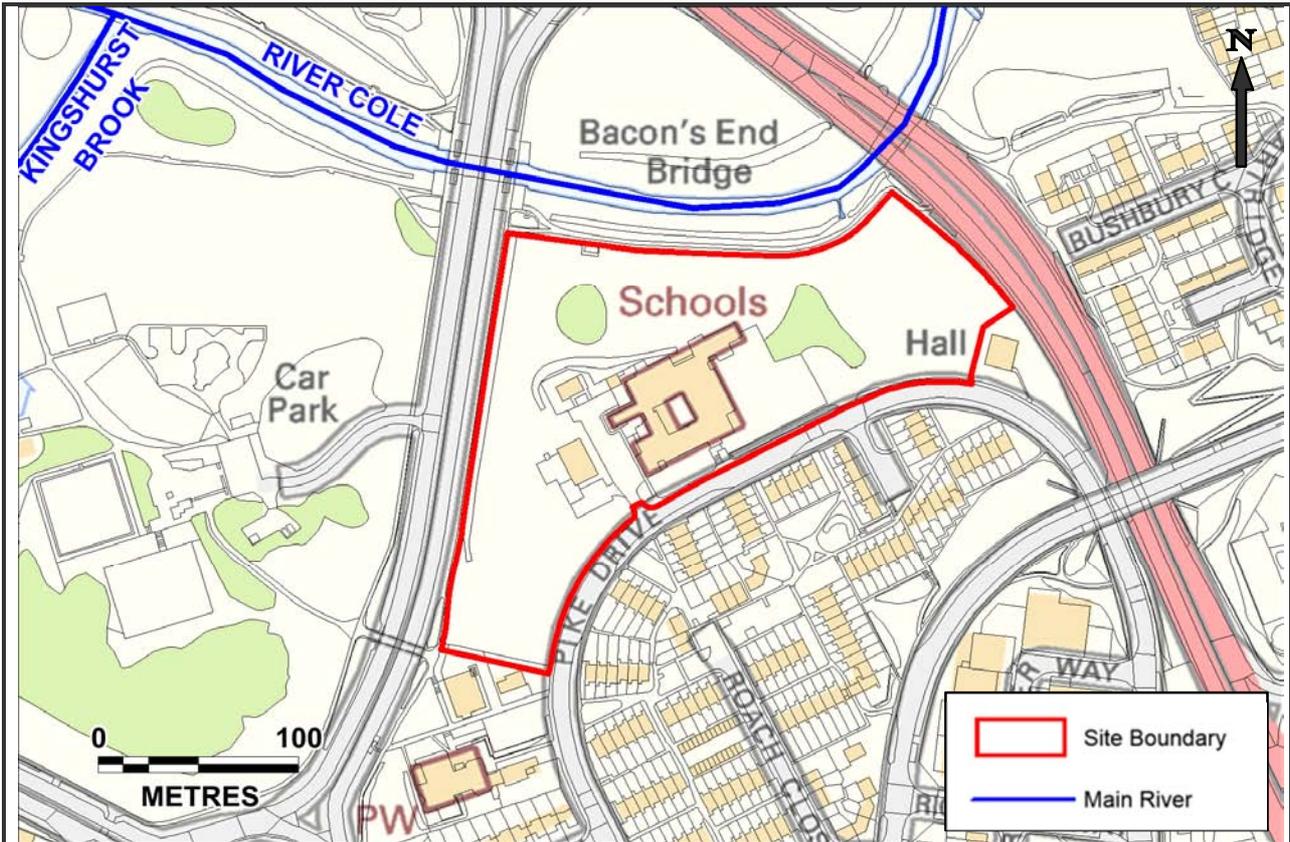
**Site-Specific FRA Guidance**

- Following consultation with the Environment Agency to determine the most appropriate Flood Zones at the site, should development pressure create a need to develop within any area identified as being affected by fluvial flooding from Kingshurst Brook, appropriate mitigation measures should then be incorporated to enable development within the defined extents of Flood Zone 3 plus climate change ( $> 1\%$  AEP + CC). Appropriate minimum floor levels to adopt should be determined as part of a site specific FRA in agreement with the Environment Agency. Such development should not increase the risk of flooding to surrounding areas (i.e. flood volume compensation on a ‘level for level’ basis will be required elsewhere within the site boundary within a lower flood risk zone (Flood Zone 2 or 1)).
- A site-specific FRA with a focus on surface water management will be required for any development which exceeds 1 Ha applying consideration of surface water management options. It will be necessary as part of the site-specific FRA to quantify the volumes of surface water runoff to be discharged (subject to consultation with the LLFA and/or EA), and the suitability and applicability of SuDS techniques to be incorporated into the development to reduce the flood risk posed should be demonstrated.
- The FRA should demonstrate suitable provision for safe, dry access and egress to/from the site, taking into account any requirements of the SMBC emergency plan.
- An agreement in principle from ST that foul drainage from the site will be accepted into their network should be sought as part of a site specific FRA accompanying any planning application for the site.

The proposed on site surface water drainage system should be designed to the Sewers for Adoption (6th Edition).

- A site-specific FRA should consider the likelihood and impact of groundwater emergence.
- To define the relative risk of groundwater flooding and SuDS suitability, an FRA should be informed by a suitable site GI.
- Appropriate mitigation and resilience measures should be incorporated into the design of the development so as not to increase the risk of flooding to surrounding areas by obstructing any flood flow routes.

4.4 Table 4-2: Site 4 - Bishop Wilson School and St Andrew’s Scout Hut, Pike Drive, Chelmsley Wood



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**Figure 4-2: Site Location Plan – Site 4 Bishop Wilson School and St Andrew’s Scout Hut Pike Drive, Chelmsley Wood**

Site Information	
Site Area	3.1 Ha
Existing Land Use and Topography	<p>OS mapping (Figure 4-2) and aerial photography illustrate that the site is located between the A452 Chester Road, Moorend Avenue and Pike Drive. It is presently occupied by the Bishop Wilson Church of England Junior and Infant School, and St. Andrew’s Scout Hut, including a small number of outbuildings, access roads and car parking areas.</p> <p>The remaining majority of the site is occupied by playing fields and public open grassland bordered by trees connecting the Cole Bank Local Nature Reserve with Kingfisher Country Park. Two small wooded areas are located in the north. These areas of the site are therefore classified as greenfield.</p> <p>OS Panorama data illustrates that the site generally slopes downhill in a north-easterly direction towards the River Cole from approximately 94 mAOD in the south west down to 80 mAOD along the northern boundary.</p>
Proposed Use and Vulnerability Classification	<p>The site is identified as Site 4 in the adopted Local Plan, and Chelmsley Wood Site 185 in the Solihull SHLAA within the North Solihull Regeneration Area.</p> <p>The adopted Local Plan identifies the site as having the capacity for a total of 140 residential dwellings. A Planning Application (ref. 2013/1726) for the development of 106 residential dwellings with associated car parking and provision of access roads and landscaping within the western region of the site was submitted to SMBC. This included a site specific FRA. Full planning approvals for the proposals were granted in January 2014. This Level 2 SFRA has therefore be undertaken in consideration of the remaining eastern region of the site, and in the event that the approved planning proposals do not</p>

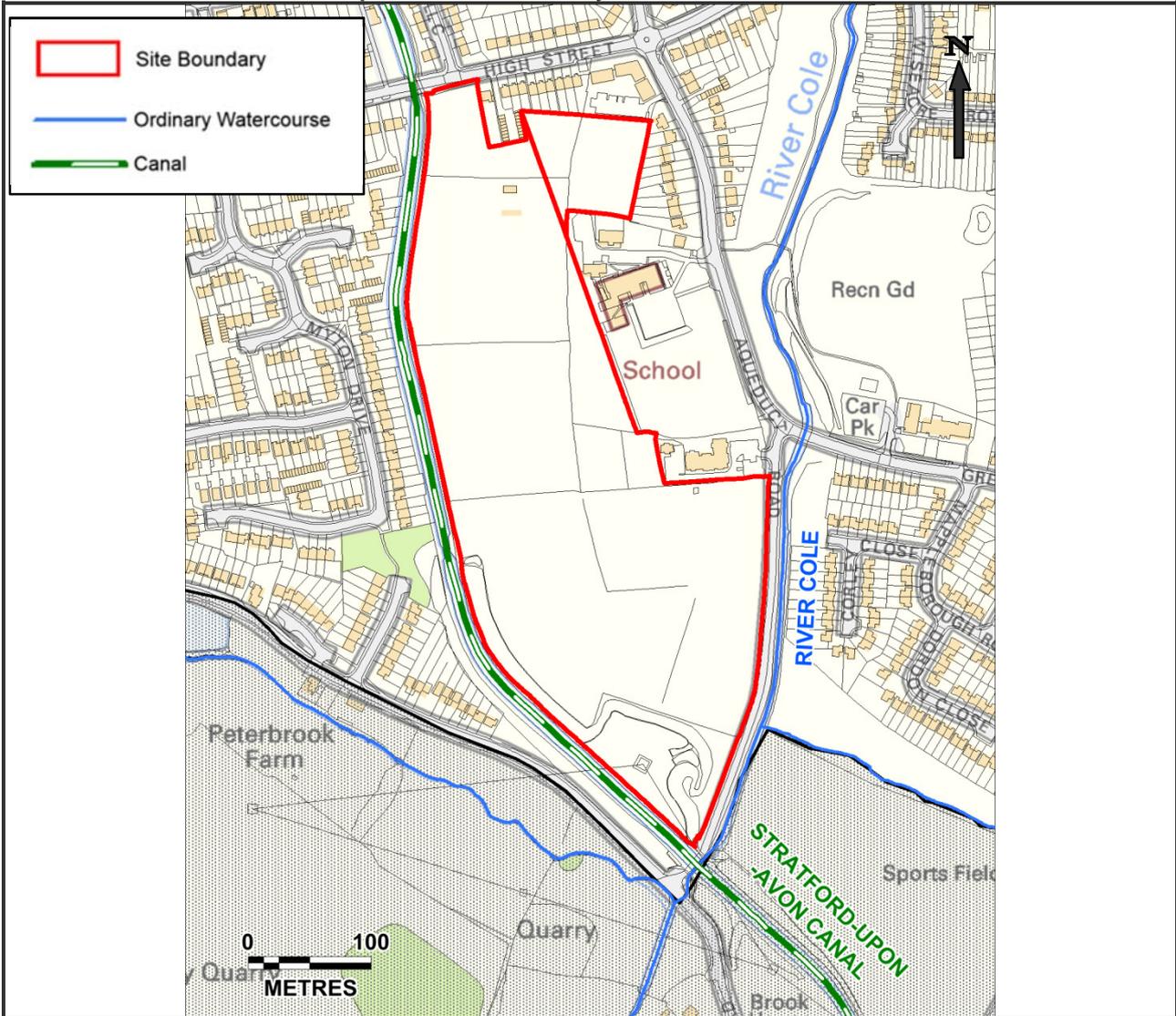
	<p>commence.</p> <p>Under the NPPF, residential development is classified as ‘more vulnerable’ and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a provided the Exception Test is passed. Transport infrastructure is considered to be ‘essential infrastructure’ and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a and 3b provided the Exception Test is passed. Landscaping is classified as ‘water compatible’ and as such is considered appropriate in all Flood Zones.</p>
<p><b>Sources of Flood Risk</b></p>	
Rivers	<p>OS mapping (Figure 4-2) illustrates the River Cole (a Main River) flowing in an easterly direction adjacent to the northern boundary of the site. Kingshurst Brook (a Main River) flows in a north easterly direction approximately 300 m to the west of the site.</p> <p>As shown in Figure A-1 in Appendix A, the Environment Agency’s Flood Map (undefended) illustrates that Flood Zone 2 (<math>\geq 0.1\%</math> AEP of flooding) associated with the River Cole encompasses an area along the northern edge of the site. The remainder of the site is shown to be located within Flood Zone 1 (<math>&lt; 0.1\%</math> AEP of flooding).</p> <p>However, the more detailed ISIS-TUFLOW 2D model produced as part of the Chelmsley Wood Hydraulic Modelling Study (2011) (Figure C-1, Appendix C) illustrates that a larger area of the site in the north and north-west falls within Flood Zone 2 (<math>\geq 0.1\%</math> AEP of flooding) for the River Cole. A slightly larger area in the north western region of the site also falls within Flood Zone 3 (<math>\geq 1\%</math> AEP of flooding) and the Flood Zone 3 plus an allowance for climate change (<math>\geq 1\%</math> AEP+CC) flood outline.</p> <p>It is noted that the Environment Agency confirmed that their Flood Maps are to be updated accordingly as a result of a challenge made with these latest model results, but at the time of submission of this report, this has not yet occurred. Therefore, for the purposes of this study, the current Flood Zones illustrated in Appendix A Figure A-1 are the most appropriate dataset for comparison with Site 4..</p> <p>Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) identify no historical incidents of fluvial flooding have been recorded at the site.</p>
Surface Water	<p>The Environment Agency’s uFMfSW (Figure A-2 in Appendix A) illustrates that the risk of flooding from surface water runoff from land is predominantly very low (<math>&lt; 0.1\%</math> AEP of flooding). However, areas at low risk (<math>\geq 0.1\%</math> AEP of flooding) are illustrated across two main routes proceeding northwards through the western and eastern regions of the site along the lowest elevated ground.</p> <p>A small area identified as being at a medium risk (<math>\geq 1\%</math> AEP of flooding) was identified within the eastern region of the site, and an area at high risk (<math>\geq 3.33\%</math> AEP of flooding) was identified along the southern boundary alongside Pike Drive.</p> <p>Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) illustrate no historical incidents of surface water flooding have been reported at the site or immediate vicinity.</p>
Geology and Groundwater	<p>BGS mapping (see Section 6.2) and the Environment Agency’s Aquifer Designation map (see Section 6.4) identifies that the entire site is underlain by a layer of Mercia Mudstone bedrock classified as a ‘Secondary B’ aquifer. Secondary B aquifers are predominantly less permeable layers and yield limited amounts of groundwater. The northern edge and south western corner of site are overlain by a layer of alluvium superficial deposits consisting of clay, silt, sand and gravel designated as a ‘Secondary A’ aquifer. Secondary A aquifers are only capable of supporting water supplies at a local level, often being an important source of base flow to rivers.</p> <p>The Environment Agency’s AStGWF map (Figure A-3 in Appendix A) illustrates that the site lies within a 1 km grid square where between 25% and 50% of the area is considered to be susceptible to groundwater emergence.</p>
Sewers	<p>The ST DG5 register (Figure A-8 in Appendix A) identifies no recorded incidents of sewer flooding within the site or immediate vicinity between 1993 and 2013.</p>
Artificial Sources	<p>There are no canals or elevated/impounded reservoirs in the vicinity of the site. Therefore, no further assessment of these is required as part of this Level 2 SFRA.</p>

<b>Flood Defence Infrastructure</b>
The NFCDD identifies no existing raised flood defence infrastructure present along the reach of the River Cole or Kingshurst Brook within the local vicinity. No analysis of defences overtopping was therefore required.
<b>Residual Flood Risks</b>
As no raised flood defences are present, no defence breach failure analysis was required. The 'Risk of Flooding from Reservoirs' maps on the Environment Agency's website illustrates no risk of inundation from breach failure of any reservoirs upstream of the site. Therefore, no further assessment of these is required as part of this Level 2 SFRA.
<b>Recommendations and Policies</b>
<ul style="list-style-type: none"> <li>• As part of a site specific FRA it is recommended that the Environment Agency be consulted further to determine their current position on the further detailed modelling output for the River Cole defined as part of the Chelmsley Wood Hydraulic Modelling Study (2011).</li> <li>• Where possible, any further proposed development on the remaining eastern region of the site should be rolled back to outside the Environment Agency's undefended Flood Zone 2 (<math>\geq 0.1\%</math> AEP of flooding) and Flood Zone 3 (<math>\geq 1\%</math> AEP of flooding) extents for the River Cole, to create a 'blue corridor' that provides reduced flood risk, wildlife habitat and public amenity areas. Any development subsequently proposed within the adopted Flood Zone 1 (<math>&lt; 0.1\%</math> AEP of flooding) will be considered to pass the Sequential Test on the grounds of fluvial flood risk.</li> <li>• If there remains a requirement to develop within the adopted Flood Zone 3 (<math>\geq 1\%</math> AEP of flooding) outline of the River Cole, then a detailed FRA will be required to demonstrate that the Exception Test can be passed through a review of the flood depths and hazard classifications within the defined extents to ensure it is safe.</li> <li>• It is recommended that development does not encroach within a minimum of 8 m of the watercourse banks of the River Cole, which is the EA's by-law distance for maintenance access along Main Rivers in the Staffordshire, Warwickshire and West Midlands Region. This would be beneficial in terms of flood risk, wildlife habitat and amenity potential.</li> <li>• Surface water/pluvial flood risk should also inform any proposed site layout such that the most vulnerable parts of the proposed development are avoided in locations shown to be at the highest risk of pluvial flooding. Overland flow routes should be considered in the development design. Appropriate mitigation measures should be investigated and implemented to prevent this source of flooding from causing any detrimental impact to the development or surrounding land uses.</li> <li>• As the area is primarily greenfield, any impermeable development within the area will increase surface water runoff (unless attenuated). A surface water management framework should be adopted as part of a masterplan to limit and, where possible, reduce surface water runoff rates and volumes from the developed site to greenfield runoff rates and volumes as required by the Environment Agency to prevent any resultant increase in flood risk posed downstream. NPPF states that SuDS should, where possible, mimic the natural drainage mechanism of an area. Infiltration is part of the natural drainage process. Environment Agency advice indicates a presumption in favour of infiltration SuDS techniques being used wherever possible.</li> <li>• The review of the BGS data and Environment Agency Aquifer Designation maps suggest that infiltration SuDS may be feasible within the northern and south-western regions of site and therefore infiltration techniques may be more appropriate here as the groundwater is likely to support the base flow of the River Cole. Attenuation SuDS techniques may be more preferable across the remainder of the site.</li> <li>• Detailed site-specific analysis and GI should be undertaken before the use of infiltration SuDS techniques is dismissed pending the outcome of any contamination assessment/remediation works.</li> </ul>

**Site-Specific FRA Guidance**

- Following consultation with the Environment Agency to determine the most appropriate Flood Zones at the site, should development pressure create a need to develop within the areas identified as being affected by fluvial flooding from the River Cole, appropriate mitigation measures should then be incorporated to enable development within the defined extents of Flood Zone 3 plus climate change (>1% AEP + CC). Appropriate minimum floor levels to adopt should be determined as part of a site specific FRA in agreement with the Environment Agency. Such development should not increase the risk of flooding to surrounding areas (i.e. flood volume compensation on a 'level for level' basis will be required elsewhere within the site boundary within a lower flood risk zone (Flood Zone 2 or 1)).
- A site-specific FRA with a focus on surface water management will be required for any development which exceeds 1 Ha applying consideration of surface water management options. It will be necessary as part of the site-specific FRA to quantify the volumes of surface water runoff to be discharged (subject to consultation with the LLFA and/or EA), and the suitability and applicability of SuDS techniques to be incorporated into the development to reduce the flood risk posed should be demonstrated.
- The FRA should demonstrate suitable provision for safe, dry access and egress to/from the site, taking into account any requirements of the SMBC emergency plan.
- An agreement in principle from ST that foul drainage from the site will be accepted into their network should be sought as part of a site specific FRA accompanying any planning application for the site. The proposed on site surface water drainage system should be designed to the Sewers for Adoption (6th Edition).
- A site-specific FRA should consider the likelihood and impact of groundwater emergence.
- To define the relative risk of groundwater flooding and SuDS suitability, an FRA should be informed by a suitable site GI.
- Appropriate mitigation and resilience measures should be incorporated into the design of the development so as not to increase the risk of flooding to surrounding areas by obstructing any flood flow routes.

4.5 Table 4-3: Site 15 - Aqueduct Road, Shirley



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**Figure 4-3: Site Location Plan – Site 15 Aqueduct Road, Shirley**

Site Information	
Site Area	10.3 Ha
Existing Land Use and Topography	<p>OS mapping (Figure 4-3) and aerial photography illustrate that the site is located in the Shirley area of Solihull to the south of High Street and east of Aqueduct Road. It is presently occupied by open green space considered to be greenfield, and is utilised as a horse grazing paddock with a single outbuilding.</p> <p>OS Panorama data illustrates that the site slopes downhill in a south-easterly direction towards the River Cole and Kingshurst Brook. Land heights range from approximately 138 mAOD in the north down to 129 mAOD at the southern corner of the site.</p>
Proposed Use and Vulnerability Classification	<p>The site is identified as Site 15 in the adopted Local Plan, and Shirley Sites 22 and 171 in the Solihull SHLAA within the Mature Suburbs Area.</p> <p>The adopted Local Plan identifies the site as having the capacity for a total of 300 residential dwellings. A Planning Application (ref. 2012/1567) for the development of 200 residential properties with associated car parking and provision of access roads, infrastructure and open space across the majority of the site was submitted to SMBC.</p>

This included a site specific FRA. Full planning approvals for the proposals were granted in January 2014 following a Section 106 agreement being reached. This Level 2 SFRA has therefore be undertaken in consideration of the remainder of the site (comprising the southern extent, and north-eastern area identified as site 171 in the SHLAA), and in the event that the approved planning proposals do not commence.

Under the NPPF, residential development is classified as ‘more vulnerable’ and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a provided the Exception Test is passed. Transport infrastructure is considered to be ‘essential infrastructure’ and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a and 3b provided the Exception Test is passed. Landscaping and open space is classified as ‘water compatible’ and as such is considered appropriate in all Flood Zones.

**Sources of Flood Risk**

**Rivers** OS mapping (Figure 4-3) illustrates the River Cole (an ordinary watercourse in this location) flowing in a north-easterly direction alongside the eastern border of the site. Peter Brook (an ordinary watercourse converges with the River Cole immediately south of the site.

As shown in Figure A-1 in Appendix A, the Environment Agency’s Flood Map (undefended) illustrates that Flood Zone 2 ( $\geq 0.1\%$  AEP of flooding) and Flood Zone 3 ( $\geq 1\%$  AEP of flooding) associated with the River Cole encompasses an area in the eastern region of the site (approximately 15%). The remaining majority of the site is shown to be located within Flood Zone 1 ( $<0.1\%$  AEP of flooding). The southern half of the site is located within an Environment Agency Flood Alert area (see Section 8.8 and Appendix A, Figure A-4).

Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) identify no historical incidents of fluvial flooding have been recorded at the site. However, one historical fluvial flood incident located approximately 25 m to the south at the junction of Aqueduct Road with Peterbrook Road was reported to SMBC. Frequent flooding of Aqueduct Road from overland flow generated by the existing site and the River Cole was also raised as an issue raised by the Environment Agency at the Level 2 SFRA inception meeting.

The proposed development provided an opportunity to reduce the scale of pluvial flooding of Aqueduct Road. In addition to other surface water management measures within the site, a large flood alleviation pond has therefore been proposed mitigating runoff of overland flows to greenfield runoff rates and volumes as part of a Section 106 agreement. The pond is to be located in the eastern region of the site adjacent to Aqueduct Road within Flood Zone 2, and will contribute towards reducing the overall flood risk at the site.

**Surface Water** The Environment Agency’s uFmFSW (Figure A-2 in Appendix A) illustrates that the risk of flooding from surface water runoff from land is predominantly very low ( $<0.1\%$  AEP of flooding). However, areas at low risk ( $\geq 0.1\%$  AEP of flooding) are illustrated in the northern, south-western and eastern regions of the site along the lowest elevated ground. A notable area identified as being at a medium risk ( $\geq 1\%$  AEP of flooding) was identified within the eastern region of the site, and areas at high risk ( $\geq 3.33\%$  AEP of flooding) were identified along the eastern boundary and in the south western region of the site.

Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) illustrate no historical incidents of surface water flooding have been reported at the site. However, one historical pluvial flood incident located approximately 150 m to the west on Myton Drive was reported to the Fire Service.

**Geology and Groundwater** BGS mapping (see Section 6.2) and the Environment Agency’s Aquifer Designation map (see Section 6.4) identifies that the entire site is underlain by a layer of Mercia Mudstone bedrock classified as a ‘Secondary B’ aquifer. Secondary B aquifers are predominantly less permeable layers and yield limited amounts of groundwater. The entire site is overlain by a layer of alluvium superficial deposits consisting of clay, silt, sand and gravel designated as a ‘Secondary A’ aquifer. Secondary A aquifers are only capable of supporting water supplies at a local level, often being an important source of base flow to rivers.

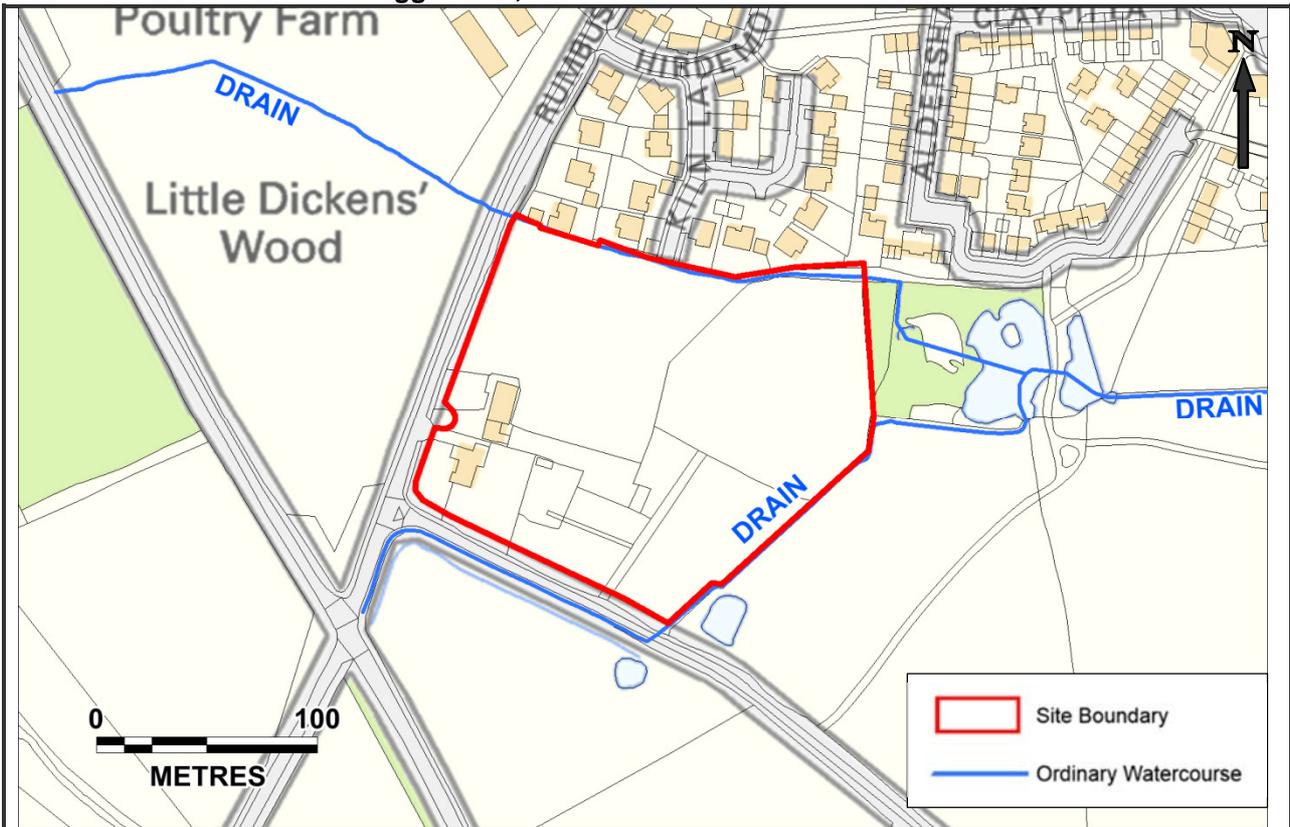
	<p>The Environment Agency’s AStGWF map (Figure A-3 in Appendix A) illustrates that the site lies within a 1 km grid square where between 50% and 75% of the area is considered to be susceptible to groundwater emergence. The north-western edge of the site lies within a 1 km grid square where between 25% and 50% of the area is considered to be susceptible to groundwater emergence.</p>
Sewers	<p>The ST DG5 register (Figure A-8 in Appendix A) identifies no recorded incidents of sewer flooding within the site between 1993 and 2013. However, one historic foul sewer flooding incident was reported approximately 200 m east of the site on Wisacre Croft.</p>
Artificial Sources	<p>The Stratford-upon-Avon Canal forms the western boundary of the site. The southern approximately 300 m of this reach comprises a raised embankment and a safety gate (see Inset 2 in Figure A-1 Appendix A) to facilitate the aqueduct crossing over the River Cole. The canal therefore may present a risk of flooding to the site by overtopping or breach failure.</p> <p>Neither the PFRA nor the Level 1 SFRA identified any historical flooding events along this reach of the Stratford-upon-Avon Canal adjacent to Site 15. The CRT also confirmed that they hold no records of breach or overtopping in the vicinity.</p>
<p><b>Flood Defence Infrastructure</b></p>	
<p>The NFCDD identifies no existing raised flood defence infrastructure present along the reach of the River Cole adjacent to the site or within the local vicinity. No defence overtopping analysis was therefore required.</p>	
<p><b>Residual Flood Risks</b></p>	
<p>No raised flood defences are present along the reach of the River Cole adjacent to the site; therefore no defence breach analysis was required.</p> <p>The CRT own, operate and maintain the Stratford-upon-Avon Canal embankment, the safety gate and aqueduct identified. These structures are used to manage and maintain water levels within this embanked section of the canal (see more information in Section 3.5) and in doing so, provide a function for reducing flood risk to the surrounding area.</p> <p>In the unlikely event that a breach was to occur in the embankment, the risk posed to the site would be proportional to the limited volume of water held between two locks/gates. The resultant extents, depths and rates of inundation should be quantified as part of a detailed FRA and used to determine the requirements for raising floor levels and flood proofing properties that may be affected to mitigate the residual risk of canal flooding.</p> <p>The ‘Risk of Flooding from Reservoirs’ maps on the Environment Agency’s website illustrates no risk of inundation from breach failure of any reservoirs upstream of the site.</p>	
<p><b>Recommendations and Policies</b></p>	
<ul style="list-style-type: none"> <li>• Should any revised proposals be submitted for the majority of the site, it should be rolled back to outside the Environment Agency’s undefended Flood Zone 2 (<math>\geq 0.1\%</math> AEP of flooding) and Flood Zone 3 (<math>\geq 1\%</math> AEP of flooding) extents for the River Cole, to create a ‘blue corridor’ that provides reduced flood risk, wildlife habitat and public amenity areas.</li> <li>• Any further proposed development within the remaining area of the site will be located within the Environment Agency’s undefended Flood Zone 1 (<math>&lt; 0.1\%</math> AEP of flooding) and therefore is considered to pass the Sequential Test on the grounds of fluvial flood risk.</li> <li>• If it is proposed that residential development will be located within the adopted Flood Zone 3 (<math>\geq 1\%</math> AEP of flooding) outline, then a detailed FRA will be required to demonstrate that the Exception Test can be passed through a review of the flood depths and hazard classifications within the defined extents to ensure that it is safe.</li> <li>• Any works in or within close proximity to ordinary watercourse requires consent under the Land Drainage Act 1991. The consenting engineer at SMBC will need to be consulted on the proposals for the site.</li> <li>• It is recommended that SMBC, as the LLFA, should be contacted during the undertaking of an FRA to determine their requirements for a margin for maintenance either side of the ordinary watercourse banks. This would be beneficial in terms of flood risk, wildlife habitat and amenity potential.</li> </ul>	

- Surface water/pluvial flood risk should also inform any proposed site layout such that the most vulnerable parts of the proposed development are avoided in locations shown to be at the highest risk of pluvial flooding.
- As the area is primarily greenfield, any impermeable development within the area will increase surface water runoff (unless attenuated). A surface water management framework should be adopted as part of a masterplan to limit and, where possible, reduce surface water runoff rates and volumes from the developed site to greenfield runoff rates and volumes as required by the Environment Agency to prevent any resultant increase in flood risk posed downstream. NPPF states that SuDS should, where possible, mimic the natural drainage mechanism of an area. Infiltration is part of the natural drainage process. Environment Agency advice indicates a presumption in favour of infiltration SuDS techniques being used wherever possible.
- The review of the BGS data and Environment Agency Aquifer Designation maps suggest that infiltration SuDS may be feasible across the entire site and therefore infiltration techniques may be more appropriate here as the groundwater is likely to support the base flow of the River Cole. However, the FRA submitted with the approved planning application determined from a GI that infiltration techniques were unsuitable due to high groundwater levels detected. Therefore, attenuation SuDS techniques may be more suitable.
- Detailed site-specific analysis and GI should be undertaken of the remainder of the site before the use of infiltration SuDS techniques is dismissed pending the outcome of any contamination assessment/remediation works.

#### Site Specific FRA Guidance

- A site-specific FRA with a focus on surface water management will be required for any development which exceeds 1 Ha applying consideration of surface water management options. It will be necessary as part of the site-specific FRA to quantify the volumes of surface water runoff to be discharged (subject to consultation with the LLFA and/or EA), and the suitability and applicability of SuDS techniques to be incorporated into the development to reduce the flood risk posed should be demonstrated.
- Should development pressure create a need to develop within the areas identified as being affected by flooding from the River Cole, appropriate mitigation measures should then be incorporated to enable development within the defined extents of Flood Zone 3 (>1% AEP of flooding). Appropriate minimum floor levels to adopt should be determined as part of a site specific FRA in agreement with the Environment Agency. Such development should not increase the risk of flooding to surrounding areas (i.e. flood volume compensation on a 'level for level' basis will be required elsewhere within the site boundary within a lower flood risk zone).
- The FRA should demonstrate suitable provision for safe, dry access and egress to/from the site, taking into account any requirements of the SMBC emergency plan.
- Appropriate mitigation and resilience measures should be incorporated into the design of the development so as not to increase the risk of flooding to surrounding areas by obstructing any flood flow routes.
- An agreement in principle from ST that foul drainage from the site will be accepted into their network should be sought as part of a site specific FRA accompanying any planning application for the site. The proposed on site surface water drainage system should be designed to the Sewers for Adoption (6th Edition).
- A site-specific FRA should consider the likelihood and impact of groundwater emergence.
- To define the relative risk of groundwater flooding and SuDS suitability, an FRA should be informed by a suitable site GI.

4.6 Table 4-4: Site 17 Braggs Farm, Dickens Heath



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Figure 4-4: Site Location Plan – Site 17 Braggs Farm, Dickens Heath

Site Information	
Site Area	2.6 Ha
Existing Land Use and Topography	<p>OS mapping (Figure 4-4) and aerial photography illustrate that the site is predominantly greenfield comprising open agricultural land and paddocks, with the exception of a residential property that includes stables. The site encompasses a Local Wildlife Site and is bordered by Rumbush Lane to the west, Braggs Farm Lane to the south and a residential area to the north off Kiln Lane.</p> <p>OS Panorama data illustrates that the site is generally flat. Site levels range from around 142 mAOD in the western boundary of the site down to approximately 140 mAOD in the north-east.</p>
Proposed Use and Vulnerability Classification	<p>The site is identified as Site 17 in the adopted Local Plan, and Dickens Heath Site 31 and Site 86 in the Solihull SHLAA, within the Rural Area.</p> <p>The adopted Local Plan identifies the site as having the capacity for a total of 105 residential dwellings. A Full Planning Application (ref. 2013/1478) was submitted to SMBC for a proposed development of 71 residential dwellings with associated car parking and provision of access roads, infrastructure, landscaping, open space and other ancillary works. This included a site specific FRA. Full planning approvals were refused however on the 31<sup>st</sup> January 2014, partly on the grounds of insufficient flood risk information.</p> <p>Under the NPPF, residential development is classified as ‘more vulnerable’ and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a provided the Exception Test is passed. Transport infrastructure and ancillary works are considered to be ‘essential infrastructure’ and are considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a and 3b provided the Exception Test is passed. Landscaping is</p>

	classified as 'water compatible' and as such is considered appropriate in all Flood Zones.
<b>Sources of Flood Risk</b>	
Rivers	<p>OS mapping (Figure 4-4) illustrates an un-named ordinary watercourse that issues from a culvert beneath Rumbush Lane, flowing in an easterly direction forming the northern boundary of the site. A second un-named ordinary watercourse issues to the south-west and flows along the south side Braggs Farm Lane before re-directing north-eastwards along the eastern boundary of the site. This ordinary watercourse converges with the second ordinary watercourse approximately 70 m to the east of the site. These are upper tributaries of Mount Brook.</p> <p>OS mapping (Figure 4-4) illustrates two ponds adjacent the north-eastern corner of the site boundary, and two smaller ponds adjacent the south-eastern corner of the site. However, these ponds are not impounded above adjacent ground levels or elevated above the lowest ground levels within the site boundary.</p> <p>As shown in Figure A-1 in Appendix A, the Environment Agency's Flood Map (undefended) illustrates that entire site is located within Flood Zone 1 (&lt;0.1% AEP of flooding). However, the Environment Agency does not hold flood outlines or flood level data for the un-named ordinary watercourses bordering the site, and therefore the fluvial flood risk from these sources is yet to be determined.</p> <p>Environment Agency and SMBC HFMs illustrate no historical incidents of fluvial flooding have been recorded within the site (Figure A-5A in Appendix A). However, Figure A-5A does illustrate one flood incident recorded by SMBC along the Rumbush Lane carriageway approximately 50 m to the north of the site. This location was identified by SMBC as being susceptible to frequent flooding from a combination of surface water runoff and of fluvial flows of the un-named watercourse surcharging the culvert through which they are conveyed beneath the road. A second location was identified by SMBC as having experienced an identical issue; carriageway flooding resulting from a combination surface water runoff and the second un-named watercourse surcharging the culvert beneath the Braggs Farm Lane.</p> <p>SMBC identified that insufficient culvert capacities beneath the roads was the primary cause for the historical instances of flooding, exacerbated by the topography that concentrates flows at these locations. To alleviate this problem, emergency measures are being implemented by SMBC to allow highway runoff to discharge more efficiently into the ordinary watercourses downstream of the culverts.</p> <p>The area to the south of Dickens Heath (including the area surrounding the ponds immediately to the east of the site) suffered extensive flooding during November 2012. The sources, mechanisms and consequences were investigated by Solihull MBC as part of a FWMA Section 19 Investigation. It was identified that the main cause of flooding was the discharge capacity restriction of a culvert conveying the ordinary watercourse downstream of the site beneath the Stratford-upon-Avon Canal, and a trash screen on the culvert entrance that is easily blocked. Improvement works are currently being undertaken as part of a development proposal approved at the adopted Local Plan Site 18 to the south of Griffin Lane.</p>
Surface Water	<p>The Environment Agency's uFMfSW (Figure A-2 in Appendix A) illustrates that approximately half of the site is at a very low (&lt;0.1% AEP) risk of flooding from surface water runoff from the land. However, areas at low risk (<math>\geq 0.1\%</math> AEP of flooding) are illustrated predominantly alongside the ordinary watercourse in the northern and eastern areas of the site. Smaller areas within these extents are identified as being at a medium risk (<math>\geq 1\%</math> AEP of flooding) and at high risk (<math>\geq 3.33\%</math> AEP of flooding), including in the north western corner of the site alongside Rumbush Lane, in the north near Kiln Lane and in the eastern region of the site along the lowest elevated ground.</p> <p>Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) illustrate a single historical incident of flooding reported in the vicinity of the site (detailed above).</p>
Geology and Groundwater	<p>BGS mapping (see Section 6.2) and the Environment Agency's Aquifer Designation maps (see Section 6.4) identify that the entire site is underlain by a layer of Mercia Mudstone bedrock classified as a 'Secondary B' aquifer. Secondary B aquifers are predominantly less permeable layers and yield limited amounts of groundwater.</p>

	<p>The eastern region of the site is overlain by a superficial layer of alluvium consisting of clay, silt, sand and gravel pertaining to the ordinary watercourses present. Alluvium is designated as a Secondary A aquifer. Secondary A aquifers are only capable of supporting water supplies at a local level often being an important source of base flow to rivers. The south-western corner of the site is underlain with superficial deposits of till Diamicton, and the centre and north-western regions of the site are underlain by clay and silt, both classified as unproductive in terms of groundwater.</p> <p>The Environment Agency's AStGWF map (Figure A-3 in Appendix A) illustrates that the northern edge and western areas of the site lies within 1 km grid squares where between 50% and 75% of the area is considered to be susceptible to groundwater emergence. The eastern area of the site lies within a 1 km grid square where between 25% and 50% of the area is considered to be susceptible to groundwater emergence.</p> <p>A private water well is located beneath the paved driveway between the existing house and stable block. The FRA submitted with the latest Planning application for the site identified the presence of relatively shallow groundwater levels through borehole sampling. Groundwater emergence is therefore considered to potentially pose a risk to the site.</p>
<p>Sewers</p>	<p>The ST DG5 register (Figure A-8 in Appendix A) identifies no recorded incidents of sewer flooding within the site between 1993 and 2013. However, one historic foul sewer flooding incident was recorded approximately 200 m north of the site on Elvaston Way.</p> <p>A capital scheme designed in response to a single internal and three external historic flooding incidents was recently proposed by ST along Rumbush Lane along the western boundary of the site. During January 2013, this scheme was at initial feasibility stage and subsequently the instillation may now be complete.</p>
<p>Artificial Sources</p>	<p>The Stratford-upon-Avon Canal is located approximately 300 m to the east of the site, and is elevated approximately 2.5 m below the lowest ground level within the site. It is therefore not considered to pose a risk of flooding from overtopping or breach failure.</p>
<p><b>Flood Defence Infrastructure</b></p>	
<p>The NFCDD identifies no existing raised flood defence infrastructure present within the local vicinity. No defence overtopping analysis was therefore required.</p>	
<p><b>Residual Flood Risks</b></p>	
<p>No raised flood defences are present within the vicinity of the site, therefore no defence breach analysis or analysis was required.</p> <p>The 'Risk of Flooding from Reservoirs' maps on the Environment Agency's website illustrates no risk of inundation from breach failure of any reservoirs upstream of the site.</p> <p>Therefore, no further assessment of these is required as part of this Level 2 SFRA.</p>	
<p><b>Recommendations and Policies</b></p>	
<ul style="list-style-type: none"> <li>The EA's Flood Map illustrates the site as currently being located entirely within Flood Zone 1 (&lt;0.1% AEP of flooding). However, due to the presence of the un-modelled ordinary watercourse tributaries and their close hydrological connectivity to the ponds and ordinary watercourse downstream with a flooding history between the site and the canal, the EA and SMBC have recommended that detailed modelling be undertaken of these ordinary watercourses as part of a site specific Level 3 FRA to define the flood outlines for Flood Zone 2 (<math>\geq 0.1\%</math> AEP of flooding), Flood Zone 3 (<math>\geq 1\%</math> AEP of flooding), Flood Zone 3 plus an allowance for climate change (<math>\geq 1\%</math> AEP +CC) and Flood Zone 3b (5% AEP of flooding). This modelling should take into account the impact of the culvert underneath the canal at the downstream extent. A combined modelling study covering the ordinary watercourses potentially affecting Site 17 and Site 20, taking into account the potential impacts of development at both may be favourable.</li> <li>Development should then be restricted to outside the modelled Flood Zone 3 plus climate change envelope to create 'blue corridors' which provide public open space/recreation areas near these watercourses. It is recommended that SMBC, as the LLFA, should be contacted during the undertaking of an FRA to determine their requirements for a margin for maintenance either side of the ordinary watercourse banks. This would be beneficial in terms of flood risk, wildlife habitat and amenity potential.</li> </ul>	

- Any development proposed within the adopted Flood Zone 1 (<0.1% AEP of flooding) will be considered to pass the Sequential Test on the grounds of fluvial flood risk. If it is proposed that residential development will be located within the defined Flood Zone 3 plus climate change outline, then the detailed FRA will be required to demonstrate that the Exception Test can be passed through a review of the flood depths and hazard classifications within the defined extents to ensure that it is safe.
- Any works in or within close proximity to ordinary watercourses require consent under the Land Drainage Act 1991. The consenting engineer at SMBC will need to be consulted on the proposals for the site.
- There may be an opportunity to incorporate the un-named watercourses into the development proposals for the site. This should be investigated to provide opportunities to reduce flood risk to the development and improve the WFD status/potential of the watercourses.
- Surface water/pluvial flood risk should also inform any proposed site layout such that the most vulnerable parts of the proposed development are avoided in locations shown to be at the highest risk of pluvial flooding.
- As the site is primarily greenfield, any impermeable development within the area will increase surface water runoff (unless attenuated). A surface water management framework should be adopted as part of a masterplan to limit and, where possible, reduce surface water runoff rates and volumes from the developed site to site specific greenfield runoff rates and volumes as required by the Environment Agency to prevent any resultant increase in flood risk posed downstream. NPPF states that SuDS should, where possible, mimic the natural drainage mechanism of an area. Infiltration is part of the natural drainage process. Environment Agency advice indicates a presumption in favour of infiltration SuDS techniques being used wherever possible.
- The review of the BGS data and Environment Agency Aquifer Designation maps suggest that infiltration SuDS techniques may only be feasible within the eastern area of site as the groundwater is likely to support the base flow of the ordinary watercourses. Attenuation SuDS techniques may be more appropriate across the remainder of the site. However, as the FRA submitted with the current planning application identified shallow groundwater levels, attenuation SuDS techniques may be more suitable.
- Detailed site-specific analysis and GI should be undertaken of the site to demonstrate the risk from groundwater emergence, and identify the local geological composition before the use of infiltration SuDS techniques is dismissed pending the outcome of any contamination assessment/remediation works.

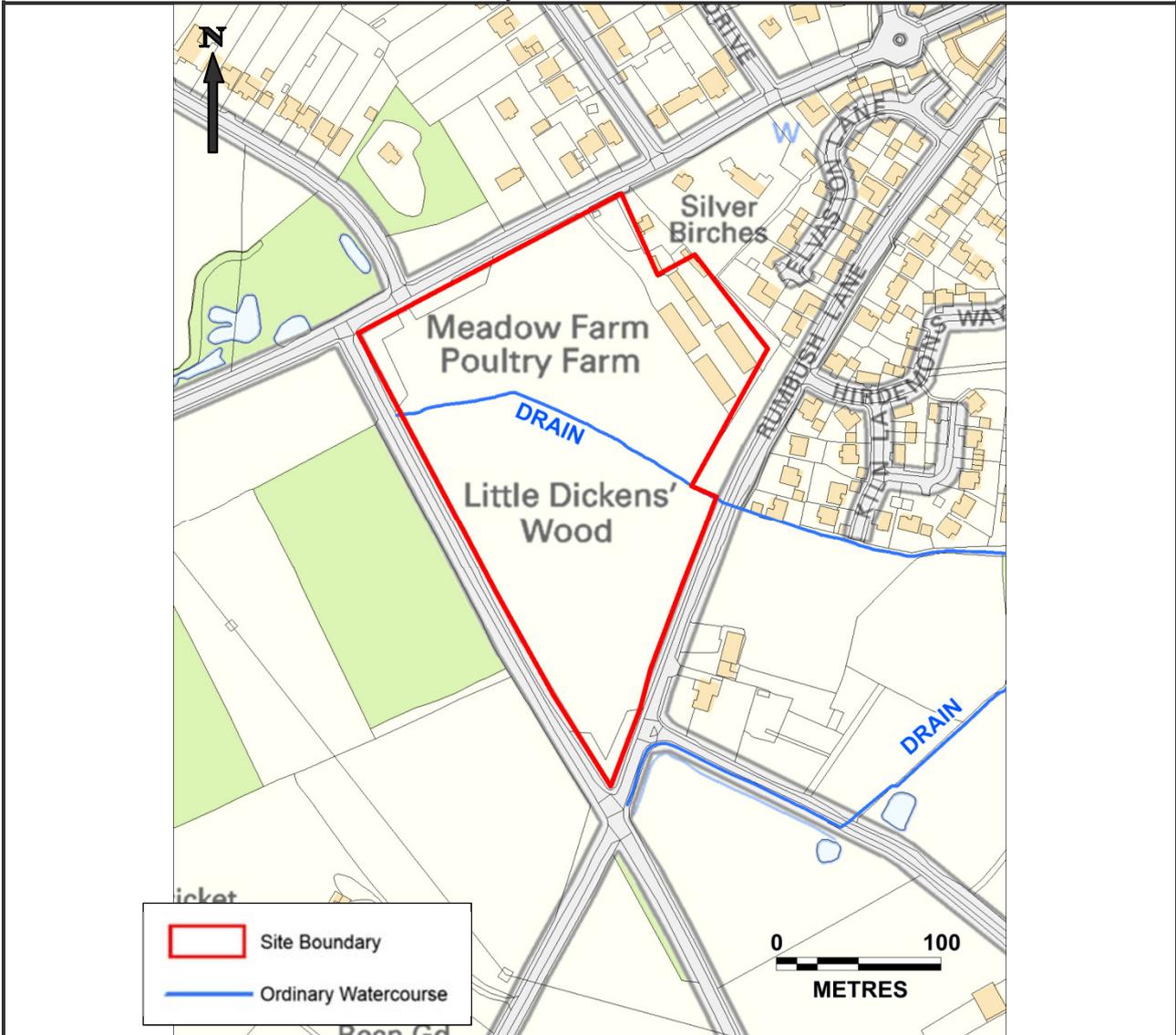
**Site Specific FRA Guidance**

- A site-specific FRA should be undertaken to quantify the risks associated with flooding from the un-modelled ordinary watercourses alongside the northern, southern and eastern boundaries of the site through detailed hydraulic modelling, taking into account potential blockage scenarios of the existing and any proposed new road culverts.
- Should development pressure create a need to develop within the areas identified as being affected by flooding, appropriate mitigation measures should then be incorporated to enable development within the defined extents of Flood Zone 3 plus climate change (1% AEP +CC) (between Flood Zone 2 and Flood Zone 3). Appropriate minimum floor levels should be determined in agreement with the EA. Such development should not increase the risk of flooding to surrounding areas (i.e. flood volume compensation on a 'level for level' basis will be required within the site boundary within a lower flood risk zone).
- A site-specific FRA should demonstrate suitable provision for dry access and egress to/from the site, taking into account any requirements of the SMBC emergency plan. Should any access routes to new development be proposed to cross the small ordinary watercourses, detailed hydraulic modelling of the watercourse will be required to inform crossing requirements (for example the size of culverts/bridge deck levels).
- Appropriate mitigation and resilience measures should be incorporated into the design of the development so as not to increase the risk of flooding to surrounding areas by obstructing any flood flow routes.
- A site-specific surface water FRA will also be required for any development including those proposed within Flood Zone 1 which exceeds 1 Ha applying consideration of surface water management options. It will be necessary to quantify the volumes of surface water runoff to be discharged (subject

to consultation with the LLFA and/or EA), and the suitability of the SuDS techniques to be incorporated.

- An agreement in principle from ST that foul drainage from the site will be accepted into their network should be sought as part of a site specific FRA accompanying any planning application for the site. The proposed on site surface water drainage system should be designed to the Sewers for Adoption (6th Edition).
- A site-specific FRA should consider the likelihood and impact of groundwater emergence.
- To define the relative risk of groundwater flooding and SuDS suitability, an FRA should be informed by a suitable site GI.

4.7 Table 4-5: Site 20 Land at Cleobury Lane, Dickens Heath



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**Figure 4-5: Site Location Plan – Site 20 Land at Cleobury Lane, Dickens Heath**

Site Information	
Site Area	4.6 Ha
Existing Land Use and Topography	<p>OS mapping (Figure 4-5) and aerial photography illustrate that the majority of the site is presently occupied by open agricultural grassland of ‘Little Dickens’ Wood’ and is bordered by large trees. It is therefore considered to be predominantly greenfield with the exception of the north eastern area that is utilised as Meadow Farm poultry farm comprising an access road and storage buildings. Dickens Heath Road, Cleobury Lane and Rumbush Lane form the north-western, south-western and eastern boundaries of the site respectively.</p> <p>OS Panorama data illustrates that the site gently slopes in an easterly direction from around approximately 146 mAOD in the north-west corner down to approximately 142 mAOD along the eastern boundary.</p>
Proposed Use and Vulnerability Classification	<p>The site is identified as Site 20 in the adopted Local Plan and Dickens Heath Site 114 in the Solihull SHLAA within the Rural Area.</p> <p>The adopted Local Plan identifies the site as having the capacity for a total of 185</p>

residential dwellings. An Outline Planning Application (ref. 2013/1504) was submitted to SMBC for a proposed development of up to 130 residential dwellings, access roads, recreation areas, open space and landscaping. However, the outline planning proposals were refused on the 31<sup>st</sup> January 2014, partly on the grounds of insufficient flood risk information.

Under the NPPF, residential development is classified as ‘more vulnerable’ and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a provided the Exception Test is passed. Transport infrastructure (including access roads) is considered to be ‘essential infrastructure’ and is considered appropriate in Flood Zones 1 and 2, and within Flood Zone 3a and 3b provided the Exception Test is passed. Landscaping and recreational spaces are classified as ‘water compatible’ and as such are considered appropriate in all Flood Zones.

**Sources of Flood Risk**

**Rivers**

OS mapping (Figure 4.5) illustrates an un-named ordinary watercourse (an upper tributary of Mount Brook) flowing in a general south-easterly direction through the centre of the site. The watercourse flows through a culvert beneath Rumbush Lane at the eastern boundary of the site and feed two ponds approximately 200 m downstream. However, these ponds are not impounded above adjacent ground levels or elevated above the lowest ground levels within the site boundary.

As shown in Figure A-1 in Appendix A, the Environment Agency’s Flood Map (undefended) illustrates that entire site is located within Flood Zone 1 (<0.1% AEP of flooding) . However, the Environment Agency does not hold flood outlines or flood level data for the un-named ordinary watercourses bordering the site, and therefore the fluvial flood risk from these sources is yet to be determined.

Environment Agency and SMBC HFMs illustrate no historical incidents of fluvial flooding have been recorded within the site (Figure A-5A in Appendix A). However, Figure A-5A does illustrate one flood incident recorded by SMBC along the Rumbush Lane carriageway approximately 50 m to the east of the site. This location was identified by SMBC as being susceptible to frequent flooding from a combination of surface water runoff and of fluvial flows of the un-named watercourse surcharging the culvert through which they are conveyed beneath the road.

SMBC identified that an insufficient culvert capacity beneath the road was the primary cause for the historical instances of flooding, exacerbated by the topography that concentrates flows at this location. To alleviate this problem, emergency measures are being implemented by SMBC to allow highway runoff to discharge more efficiently into the ordinary watercourse downstream of the culvert.

The area to the south of Dickens Heath (including the area approximately 200 m to the east of the site) suffered extensive flooding during November 2012. The sources, mechanisms and consequences were investigated by Solihull MBC as part of a FWMA Section 19 Investigation. It was identified that the main cause of flooding was the discharge capacity restriction of a culvert conveying the ordinary watercourse downstream of the site beneath the Stratford-upon-Avon Canal, and a trash screen on the culvert entrance that is easily blocked. Improvement works are currently being undertaken as part of a development proposal approved at the adopted Local Plan Site 18 to the south of Griffin Lane.

**Surface Water**

The Environment Agency’s uFMfSW (Figure A-2 in Appendix A) illustrates that approximately 75% of the site is at a very low (<0.1% AEP) risk of flooding from surface water runoff from the land. However, areas at low risk (>=0.1% AEP of flooding) are illustrated predominantly alongside the ordinary watercourse in the north-western and eastern areas of the site. Smaller areas within these extents are identified as being at a medium risk (>=1% AEP of flooding). Three smaller areas in the eastern region of the site are shown to be at high risk (>=3.33% AEP of flooding) along the lowest elevated ground.

Environment Agency and SMBC HFMs (Figure A-5A in Appendix A) illustrate a single historical incident of flooding reported approximately 50 m to the east of the site along Rumbush Lane (detailed above).

<p>Geology and Groundwater</p>	<p>BGS mapping (see Section 6.2) and the Environment Agency’s Aquifer Designation maps (see Section 6.4) identify that the entire site is underlain by a layer of Mercia Mudstone bedrock classified as a ‘Secondary B’ aquifer. Secondary B aquifers are predominantly less permeable layers and yield limited amounts of groundwater.</p> <p>The northern region of the site either side of the ordinary watercourse is overlain by a superficial layer of alluvium consisting of clay, silt, sand and gravel. Alluvium is designated as a Secondary A aquifer. Secondary A aquifers are only capable of supporting water supplies at a local level often being an important source of base flow to rivers. The western, central and northern areas of the site are underlain with superficial deposits of clay and silt, classified as unproductive in terms of groundwater. The southern region, and far northern edge of the site are underlain with superficial deposits of till Diamicton, also classified as unproductive.</p> <p>The Environment Agency’s AStGWF map (Figure A-3 in Appendix A) illustrates that the entire site lies within 1 km grid squares where between 50% and 75% of the area is considered to be susceptible to groundwater emergence.</p> <p>The FRA submitted with the latest Planning Application for the site identified the presence of relatively shallow groundwater levels through borehole sampling. Groundwater emergence is therefore considered to potentially pose a risk to the site.</p>
<p>Sewers</p>	<p>The ST DG5 register (Figure A-5B in Appendix A) identifies no recorded incidents of sewer flooding within the site between 1993 and 2013. However, one historic foul sewer flooding incident was recorded approximately 100 m north-east of the site on Elvaston Way.</p> <p>A capital scheme designed in response to a single internal and three external historic flooding incidents was recently proposed by ST along Rumbush Lane along the eastern boundary of the site. During January 2013, this scheme was at initial feasibility stage and subsequently the instillation may now be complete.</p>
<p>Artificial Sources</p>	<p>The Stratford-upon-Avon Canal is located approximately 470 m to the east of the site, and is approximately 4.5 m below the lowest ground level within the site. It is therefore not considered to pose a risk of flooding from overtopping or breach failure.</p>
<p><b>Flood Defence Infrastructure</b></p>	
<p>The NFCDD identifies no existing raised flood defence infrastructure present within the local vicinity. No defence overtopping analysis was therefore required.</p>	
<p><b>Residual Flood Risks</b></p>	
<p>No raised flood defences are present within the vicinity of the site, therefore no defence breach analysis or analysis was required.</p> <p>The ‘Risk of Flooding from Reservoirs’ maps on the Environment Agency’s website illustrates no risk of inundation from breach failure of any reservoirs upstream of the site.</p> <p>Therefore, no further assessment of these is required as part of this Level 2 SFRA.</p>	
<p><b>Recommendations and Policies</b></p>	
<ul style="list-style-type: none"> <li>• The EA’s Flood Map illustrates the site as currently being located entirely within Flood Zone 1 (&lt;0.1% AEP of flooding). However, due to the presence of the un-modelled ordinary watercourse and its close hydrological connectivity to the ordinary watercourse downstream and associated ponds with a flooding history near the canal, the EA and SMBC have recommended that detailed modelling be undertaken of this ordinary watercourse as part of a site specific Level 3 FRA to define the flood outlines for Flood Zone 2 (&gt;=0.1% AEP of flooding), Flood Zone 3 (&gt;=1% AEP of flooding), Flood Zone 3 plus an allowance for climate change (&gt;=1% AEP +CC) and Flood Zone 3b (5% AEP of flooding). This modelling should take into account the impact of the culvert underneath the canal at the downstream extent. A combined modelling study covering the ordinary watercourses potentially affecting Site 17 and Site 20, taking into account the potential impacts of development at both may be favourable.</li> <li>• Development should then be restricted to outside the modelled Flood Zone 3 plus climate change envelope to create a ‘blue corridor’ which provides public open space/recreation areas near the watercourse. It is recommended that SMBC, as the LLFA, should be contacted during the undertaking</li> </ul>	

of an FRA to determine their requirements for a margin for maintenance either side of the ordinary watercourse banks. This would be beneficial in terms of flood risk, wildlife habitat and amenity potential.

- Any development proposed within the adopted Flood Zone 1 (<0.1% AEP of flooding) will be considered to pass the Sequential Test on the grounds of fluvial flood risk. If it is proposed that residential development will be located within the defined Flood Zone 3 plus climate change outline, then the detailed FRA will be required to demonstrate that the Exception Test can be passed through a review of the flood depths and hazard classifications within the defined extents to ensure that it is safe.
- Any works in or within close proximity to ordinary watercourse requires consent under the Land Drainage Act 1991. The consenting engineer at SMBC will need to be consulted on the proposals for the site.
- There may be an opportunity to incorporate the un-named watercourse into the development proposals for the site. This should be investigated to provide opportunities to reduce flood risk to the development and improve the WFD status/potential of the watercourse.
- Surface water/pluvial flood risk should also inform any proposed site layout such that the most vulnerable parts of the proposed development are avoided in locations shown to be at the highest risk of pluvial flooding.
- As the site is primarily greenfield, any impermeable development within the area will increase surface water runoff (unless attenuated). A surface water management framework should be adopted as part of a masterplan to limit and, where possible, reduce surface water runoff rates and volumes from the developed site to site specific greenfield runoff rates and volumes as required by the Environment Agency to prevent any resultant increase in flood risk posed downstream. NPPF states that SuDS should, where possible, mimic the natural drainage mechanism of an area. Infiltration is part of the natural drainage process. Environment Agency advice indicates a presumption in favour of infiltration SuDS techniques being used wherever possible.
- The review of the BGS data and Environment Agency Aquifer Designation maps suggest that infiltration SuDS techniques may only be feasible within the central and eastern area of site as the groundwater is likely to support the base flow of the ordinary watercourse. Attenuation SuDS techniques may be more appropriate across the remainder of the site. However, as the FRA submitted with the current planning application identified shallow groundwater levels, attenuation SuDS techniques may be more suitable.
- Detailed site-specific analysis and GI should be undertaken of the site to demonstrate the risk from groundwater emergence, and identify the local geological composition before the use of infiltration SuDS techniques is dismissed pending the outcome of any contamination assessment/remediation works.

**Site-Specific FRA Guidance**

- A site-specific FRA should be undertaken to quantify the risks associated with flooding from the un-modelled ordinary watercourses alongside the northern, southern and eastern boundaries of the site through detailed hydraulic modelling, taking into account potential blockage scenarios of the existing and any proposed new road culverts.
- Should development pressure create a need to develop within the areas identified as being affected by flooding, appropriate mitigation measures should then be incorporated to enable development within the defined extents of Flood Zone 3 plus climate change (1% AEP +CC) (between Flood Zone 2 and Flood Zone 3). Appropriate minimum floor levels should be determined in agreement with the EA. Such development should not increase the risk of flooding to surrounding areas (i.e. flood volume compensation on a 'level for level' basis will be required within the site boundary within a lower flood risk zone).
- A site-specific FRA should demonstrate suitable provision for dry access and egress to/from the site, taking into account any requirements of the SMBC emergency plan. Should any access routes to new development be proposed to cross the small ordinary watercourses, detailed hydraulic modelling of the watercourse will be required to inform crossing requirements (for example the size of culverts/bridge deck levels).
- Appropriate mitigation and resilience measures should be incorporated into the design of the development so as not to increase the risk of flooding to surrounding areas by obstructing any flood flow routes.

- A site-specific surface water FRA will also be required for any development including those proposed within Flood Zone 1 which exceeds 1 Ha applying consideration of surface water management options. It will be necessary to quantify the volumes of surface water runoff to be discharged (subject to consultation with the LLFA and/or EA), and the suitability of the SuDS techniques to be incorporated.
- An agreement in principle from ST that foul drainage from the site will be accepted into their network should be sought as part of a site specific FRA accompanying any planning application for the site. The proposed on site surface water drainage system should be designed to the Sewers for Adoption (6th Edition).
- A site-specific FRA should consider the likelihood and impact of groundwater emergence.
- To define the relative risk of groundwater flooding and SuDS suitability, an FRA should be informed by a suitable site GI.

## 5 POLICY REVIEW AND UPDATES

5.1.1 Since the SMBC Level 1 SFRA was completed, updates to national planning policy and flood risk guidance have emerged. This Section highlights the main updates and the impacts they have on the SFRA.

### 5.2 National Policy

#### *National Planning Policy Framework (March 2012)*

5.2.1 The NPPF consists of a framework within which LPAs and local people can produce local and neighbourhood plans that reflect the needs and priorities of their communities.

5.2.2 The overall approach to flood risk is broadly summarised in NPPF Clause 103:

5.2.3 “When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific FRA following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and
- development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of SuDS.”

5.2.4 NPPF includes statements on policy aims, and reaffirms the need for developers and LPAs to seek opportunities to:

- reduce the overall level of flood risk in the area and beyond through the layout and form of the development;
- relocate existing development to land with a lower probability of flooding;
- create space for flooding; and
- apply appropriate SuDS.

#### *The Flood and Water Management Act (2013)*

5.2.5 Following the devastating national floods of 2007, one of the recommendations from Sir Michael Pitt’s review<sup>14</sup> was that “the role of local authorities should be enhanced so that they take on responsibility for leading the co-ordination of flood risk management in their areas”.

5.2.6 The Flood and Water Management Act (2010)<sup>15</sup> brought in new roles and responsibilities for LPAs. In particular, the Act defines the role of the LLFAs, which include Unitary Authorities or County Councils. The LLFA are encouraged to bring together relevant bodies and stakeholders to effectively manage local flood risk. These Flood Risk Management Authorities may include County, City and District/Borough Councils, IDBs, highways authorities, water companies and the Environment Agency.

5.2.7 The responsibilities that the Act assigns to LLFAs include:

- Coordinated management of flooding from surface water, ground water and ordinary watercourses,
- Development and maintenance and implementation of Flood Risk Management Strategies,
- Investigation and recording of local flood events, and
- Establishment and maintenance of a Flood Risk Asset Register.

<sup>14</sup> Sir Michael Pitt. June 2008. *The Pitt Review: Lessons learned from the 2007 floods*.

<sup>15</sup> The National Archives. HM Government. 2010. *The Flood and Water Management Act*. Available at <http://www.legislation.gov.uk/ukpga/2010/29/contents>

- 5.2.8 From 1st April 2011, SMBC became the LLFA for the Metropolitan Borough of Solihull which includes a requirement for consenting works on or near to ordinary watercourses (non Main Rivers) within their administrative areas currently consented by the Environment Agency (outside IDB authority areas). There has also been a transfer of a number of other consenting powers.
- 5.2.9 The Act gives LLFAs the role of SuDS Approving Body (SAB) which allows each Council to be responsible for adopting and maintaining SuDS. This will mean that planning applications which have drainage implications should be approved by the SAB before work can commence. However, the SAB duties of the Act have not yet been enacted and are currently under review by Government.
- 5.2.10 The LLFA has established a Local Flood Risk Management Partnership and a Local Flood Management Implementation Board to help reduce flood risk and mitigate the impact of flooding in the Borough. As the SAB, SMBC will be responsible for approving drainage systems for new development and redevelopment, and for adopting and maintaining approved SuDS serving more than one property. Developers will be expected to review and pay due regard to the recommendations included within the Local Flood Risk Strategy produced by the LLFA. The Strategy may highlight opportunities to work in partnership with the Environment Agency and the LLFA to contribute to the reduction of flood risk to new development and to third party land.

***The Flood Risk Regulations (December 2009)***

- 5.2.11 The Flood Risk Regulations (2009) transpose the EU Floods Directive (2007/60/EC) into UK Law. One of the main impacts on Local Authorities in the UK is that they are required to complete Preliminary Flood Risk Assessment (PFRA), produce Flood Risk Maps showing the extents and hazards of flooding in their area and finally, produce Flood Risk Management Plans (see Figure 5-1).



**Figure 5-1: LLFA PFRA**

- 5.2.12 The Flood Risk Regulations<sup>16</sup> came into force on the 10<sup>th</sup> December 2009 and sets out duties for the Environment Agency and LLFAs in the preparation of a range of reports and mapping outputs.
- 5.2.13 SMBC (as the LLFA) were required to prepare the following for publication by the Environment Agency before the 22<sup>nd</sup> December 2011:
  - A PFRA report for flooding from sources other than that from the sea, main rivers and reservoirs, and

<sup>16</sup> The Flood Risk Regulations. 2009. <http://www.legislation.gov.uk/uksi/2009/3042/contents/made>

- Determine whether, in the opinion of the lead local authority, there is a significant flood risk in its area and identify the part of the area, if any, where this risk exists (for sources other than that from sea, main rivers and reservoirs).

- 5.2.14 SMBC published their PFRA in May 2011. Where LLFAs identify a relevant flood risk area (as above), there was a requirement to prepare flood hazard and flood risk maps for these areas for publication by the Environment Agency before 22<sup>nd</sup> December 2013. In addition, for these areas, a flood risk management plan must be prepared for publication by the Environment Agency by 22<sup>nd</sup> December 2015.
- 5.2.15 Although the outputs of reports and mapping from the requirements of the Flood Risk Regulations will not be available for the purposes of this study, it is important to use the findings from these when updating the SFRA in the future. These should be available from the Environment Agency who has a duty to publish the required reports and mapping for river basin districts.

### 5.3 Regional Policy

- 5.3.1 The Borough of Solihull falls within two Catchment Flood Management Plans (CFMP). A CFMP is a high-level strategic planning document that provides an overview of the main sources of flood risk and how these can be managed in a sustainable framework for the next 50 to 100 years. The Environment Agency engages stakeholders within the catchment to produce policies in terms of sustainable flood management solutions whilst also considering local land use changes and effects of climate change.
- 5.3.2 The study area is covered by the River Trent and River Severn CFMPs. Brief details regarding the Draft CFMP policies were detailed within the 'Flood Warning Systems and Flood Risk Management Measures' section of the Level 1 SFRA (Section 6) published in 2008. The Final CFMP documents were released at the end of December 2009. As such, this Level 2 SFRA, being a 'Living Document', has provided a review of the updated policies that will be applicable to the Level 2 SFRA study area.

#### *Trent Catchment Flood Management Plan (December 2009)*

- 5.3.3 Within the Trent CFMP<sup>17</sup> the policy areas of importance for SMBC are Sub Area 6 (Mid Staffordshire and Lower Tame) and Sub-Area 10 (Birmingham and the Black Country).
- 5.3.4 The River Trent CFMP states that Sub Area 6 (Mid Staffordshire and Lower Tame) covering the eastern region of Solihull (pertaining to the Level 2 SFRA Sites 2 and 4) contains predominantly pastureland with open areas in the lowland area of the Upper Trent. Flood risk across this area of the catchment was identified as being generally low. Policy Option 6 was therefore adopted for Sub-Area 6:
- 5.3.5 "Areas of low to moderate flood risk where (the Environment Agency) will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits' is being adopted for this sub area."
- 5.3.6 Proposed actions to implement the preferred policy at locations deemed appropriate following more detailed appraisal and consultation include:
- Provide a more accurate and community focussed flood warning service;
  - Complete a wide ranging flood attenuation strategy for the River Tame focussing on opportunities to naturalise the river in rural areas to reduce risk to Tamworth;
  - Carry out a feasibility study to identify river restoration opportunities;
  - Identify locations where flood attenuation ponds or wetland areas could be developed with associated habitat improvements;
  - Work with aggregate companies and mineral and waste authorities to identify opportunities for collaborate restoration projects for wildlife and flood risk management; and

<sup>17</sup> Environment Agency. December 2010. *Trent Catchment Flood Management Plan*. <https://www.gov.uk/government/publications/river-trent-catchment-flood-management-plan>

- Identify problem coal mining sites in Staffordshire where discharge during flood events causes pollution and damages habitat/species in receiving watercourses.

5.3.7 The River Trent CFMP states that Sub-Area 10 (Birmingham and the Black Country) covering the western region of Solihull (pertaining to the Level 2 SFRA Sites 15, 17 and 20) is the most urbanised and populated sub area within the River Trent catchment. Land use is dominated by urbanisation and suburban areas. Flood risk across this area of the catchment was identified as being high with flooding occurring from a wide range of sources including the River Tame and its tributaries, surface water runoff, storm water drainage and sewer overflow. Policy Option 5 was therefore adopted for Sub-Area 10:

5.3.8 “Areas of moderate to high flood risk where we can generally take further action to reduce flood risk.”

5.3.9 Proposed actions to implement the preferred policy at locations deemed appropriate following more detailed appraisal and consultation include:

- Provide a more accurate and community focused flood warning service.
- Conclude River Tame flood risk management strategy.
- Reduce the incidence of foul water flooding by involving Severn Trent Water Ltd more in flood risk management.
- Investigate and promote opportunities to create green corridors along watercourses through Birmingham and the Black Country.
- Produce and implement an integrated urban drainage strategy.
- Investigate flood resilience for infrastructure, including roads, rail, electricity, gas, oil, water and telecommunications at risk of flooding within the city of Birmingham.
- Identify locations where flood storage ponds or wetland areas could be developed within the urban areas, with associated habitat creation.
- Produce an integrated flood defence asset management strategy.

#### ***Severn Catchment Flood Management Plan (December 2009)***

5.3.10 Within the Severn CFMP<sup>18</sup>, the policy area of importance to the SMBC area is Sub Area 5 (Telford, Black Country, Bromsgrove, Kidderminster and Coventry Cluster) and is mainly rural. Flood risk across this area of the catchment was identified as being relatively high, however only a small part of the council boundary falls within this catchment and does not pertain to any of the Level 2 SFRA sites so has not been considered further under the scope of this report.

## **5.4 Local Policy**

### ***SMBC Solihull Local Plan – Shaping a Sustainable Future (December 2013)***

5.4.1 SMBC issued their Local Plan to the Secretary of State for Communities and Local Government in September 2012 and following the recommended updates was adopted in December 2013. The Local Plan is the main document of the Solihull Local Development Framework and sets out how and where Solihull will become developed for the planning period 2011-2028.

5.4.2 The purpose of the Plan is to set out the long-term spatial vision for how its towns, villages and countryside will develop and change over the period, and how this vision will be delivered through a strategy for promoting, distributing and delivering sustainable development and growth.

5.4.3 The Local Plan recognises a number of key challenges across the Borough of Solihull. Those challenges which relate to flood risk are detailed below:

- ‘**Challenge F - Climate Change**’ highlights the risk of climate change to urban areas from increased surface water flooding. A key objective for this challenge is to ensure that new

<sup>18</sup> Environment Agency. December 2009. *River Severn Catchment Flood Management Plan*. <https://www.gov.uk/government/publications/river-severn-catchment-flood-management-plan>

development does not exacerbate the problem and development takes measures where possible to reduce the risks from flooding, particularly in urban areas.

- **‘Challenge L - Water Quality and Flood Risk’** identifies the increasing risk from flooding associated with new development. A key objective for this challenge is to avoid development in high risk areas, reducing flows to rivers during periods of high intensity rainfall, and ensuring that new development is designed so as to minimise surface water flood issues.
- **‘Challenge C - Sustaining the Attractiveness of the Borough for People who Live, Work and Invest in Solihull’** highlights a need to protect improve or at least conserve environmental quality and attractiveness within the residential areas of Solihull.
- **‘Challenge J - Improving Health and Well-Being’** identifies the need to improve the physical and mental health and well-being of those who visit, work and live in Solihull.

5.4.4 The Local Plan states that SMBC aims to ensure that new housing avoids areas at risk of flooding where possible and where no other sites at lower risk are available, that development is safe from the effects of flooding and does not increase the risks elsewhere.

5.4.5 Policy P11 states SMBC’s requirements and recommendations for Water Management including the following:

- “All new development shall incorporate SuDS, unless it is shown to be impractical to do so. Developers shall ensure that adequate space is made for water within the design layout of all new developments to support the full use of SuDS, and shall demonstrate that improvements to the water environment will be maximised through consideration of a range of techniques. Wherever possible, SuDS will be expected to contribute towards wider sustainability considerations, including amenity, recreation, conservation of biodiversity and landscape character, as well as flood alleviation and water quality control.”
- “On all development sites larger than 1 hectare, surface water discharge rates shall be limited to the equivalent site specific Greenfield run off rate. Developers will be expected to demonstrate that the layout and design of a development takes account of the surface water flows in extreme events so as to avoid flooding of properties, both within and outside the site. Applications for new development where there is a flood risk issue should be accompanied by a site FRA. Developers are encouraged to secure reduction of flood risk by the provision or enhancement of green infrastructure, wherever possible.”

#### ***SMBC Preliminary Flood Risk Assessment (May 2011)***

5.4.6 In May 2011 a Preliminary Flood Risk Assessment (PFRA) was produced for SMBC<sup>19</sup>. The PFRA identifies flood risk to the Borough at a high level.

5.4.7 Historic surface water flood incidents are reported to have impacted areas across Solihull concentrating in the west of the Borough. Multiple critical drainage areas are known within Solihull which are also concentrated in the west. Solihull suffered significantly during the July 2007 floods where the most significant effects were seen around Nethercote Gardens and Cheswick Green due to extensive fluvial flooding from the River Cole and the River Blythe respectively. Following this, a Local Flood Risk Management Plan (FRMP) was undertaken for the River Cole. This study determined that Combined Sewer Outfalls (CSO’s) contribute heavily to fluvial flows.

5.4.8 Historic fluvial flood events have also been reported to have impacted critical infrastructure including Birmingham Airport, the National Exhibition Centre (NEC) and the A45. No historical records of groundwater flooding have been reported however a reported increase in groundwater emergence, particularly in the Shirley area has occurred.

5.4.9 Only one reported incident of artificial flooding has been confirmed which relates to a breach of the Grand Union Canal near Copt Heath as a result of a farmer excavating the toe of the embankment resulting in slope failure. There are no reported consequences as a result of the breach and therefore it is assumed to not be significantly harmful.

<sup>19</sup> WSP. 2011. *Solihull Metropolitan Borough Council Preliminary Flood Risk Assessment*.

- 5.4.10 The PFRA identifies significant future flood risk to some parts of Solihull including the western urbanised areas of the Borough which are considered to be at more risk of flooding due to the built up nature of these areas. These areas are described to be at risk of localised ponding during the 1 in 30 and 1 in 200 annual exceedance probability events.

***SMBC Green Infrastructure Study (January 2012)***

- 5.4.11 The Green Infrastructure study for SMBC sets out how and where potential growth locations within the Borough can provide opportunities to enhance existing and identify new areas for Green Infrastructure. Green Infrastructure offers a wide range of benefits including flood water attenuation, habitat creation and water quality benefits helping water-bodies to achieve Water Framework Directive (WFD) targets.
- 5.4.12 The Green Infrastructure strategy states that SMBC should allocate formal areas within the Borough as Blue Corridors i.e. areas in Flood Zone 3 (1 in 100 year, 1% AEP floodplain) should remain undeveloped. Areas which have already been developed should become Blue Regeneration Corridors whereby redevelopment should be encouraged out of the floodplain or if this is not possible developers should be encouraged to open up culverts, naturalise existing channels and retreat development as much as possible out of the floodplain.
- 5.4.13 No purpose built flood storage areas were identified within the Borough of Solihull and it was recommended that all natural storage areas should be maintained and opportunities for de-culverting and restoring natural channels should be taken.
- 5.4.14 It was recommended that surface water runoff should be limited to greenfield rates (usually 5 litres per second per hectare) regardless of whether the existing site is brownfield or greenfield in order to fully address climate change issues and mitigate for the majority of the Borough which is not to be redeveloped (and will continue to discharge at uncontrollable rates). Above ground SuDS systems are encouraged within the Borough as they provide multifunctional Green Infrastructure. Native woodland creation and tree planting has the potential to improve water quality and alleviate/slow the rate of flooding.
- 5.4.15 Solihull's Green Infrastructure Vision includes the surveying, maintenance, enhancement and monitoring of:
- Existing accessible green spaces,
  - Existing green and blue links,
  - Existing habitats identified as high and medium biodiversity habitats,
  - Existing sites of local geodiversity value, and
  - Flood Zone 2 (1 in 1000 year, 0.1% AEP floodplain).
- 5.4.16 This vision will also include the creation of more green spaces, restoration zones, Local Nature Reserves, cycle routes, green flag parks etc.

***Emergency Flood Response Plan and Guidance for Solihull***

- 5.4.17 SMBC's approach to providing emergency assistance during times of flooding is described within the Level 1 SFRA. A summary of this information is provided below:
- Emergency assistance is on an ad hoc basis dependant on the situation,
  - If available sandbags or other equipment can be provided to assist with defence to persons or property. However once flooding has subsided it is the responsibility of the property owner to dispose of the bag and contents,
  - Engineering advice can be provided on ways that flood risk can be alleviated and general guidance provided to all on the roles and responsibilities of riparian landowners under the Land Drainage Act 1991,
  - SMBC will assist with announcing Environment Agency flood warnings where appropriate, and

- During very serious flooding i.e. the need for home evacuation and provision of temporary accommodation is covered by SMBC's Emergency Plan which is also available online at <http://www.solihull.gov.uk/emergencyplan/>.

## 5.5 Level 2 SFRA Policies

5.5.1 To ensure a holistic approach to flood risk management and make sure that flooding is taken into account at all stages of the planning process, the findings of this report should be incorporated into the emerging Local Plan for SMBC. In accordance with the NPPF, a specific policy on flood risk should be included in the Final Core Strategy to ensure that:

- Development is located in the lowest flood risk areas,
- New development is flood-proofed to a satisfactory degree and does not increase flood risk elsewhere,
- Surface water is managed effectively on site, and,
- Any development in Flood Zone 2 or Flood Zone 3 is safe.

### *Sequential Approach*

5.5.2 As outlined in Section 2.3, the application of the sequential approach should ensure that development is appropriate in terms of development vulnerability and flood risk (see Table 2-1, Table 2-2 and Table 2-3).

### *Exception Test*

5.5.3 Where application of the Exception Test is necessary (see Section 2.4), the following guidance should be considered:

- If development is to be constructed with less vulnerable uses on ground level, agreements need to be in place to prevent future alteration of these areas to more vulnerable uses without further study into flood risk;
- Single storey residential development should not normally be considered in high flood risk areas as they offer no opportunity to retreat to higher levels;
- LPAs and developers proposing 'vulnerable' development within Flood Zone 2 and Flood Zone 3 should seek opportunities to:
  - Sequentially allocate development to consider relocating existing development to land in zones with a lower probability of flooding,
  - Create space for flooding to occur by restoring functional floodplains and flood flow pathways and by identifying, allocating and safeguarding open space for storage,
  - Provide access and egress that allows safe passage for site users and emergency services;
  - Reduce flooding by considering the layout and the form of the development and the appropriate application of sustainable drainage techniques,
  - Consult with the Emergency Services during master-planning of any development in a high flood risk zone, and
  - Ensure developers incorporate flood resilience measures into the design of developments, including such measures as:
    - Replacing chipboard/MDF kitchen/bathroom units with plastic equivalents,
    - Moving service meters, boilers and electrical points above flood levels,
    - Install one-way valves into drainage pipes to prevent sewage backing up into the house, and
    - Replacing timber floors with concrete floors covered with tiles.

*Determining Impacts Upstream and Downstream*

- 5.5.4 It is imperative that new development does not increase flood risk to areas upstream or downstream of a proposed development site, through increasing surface water runoff or construction which could impede flood water conveyance, thereby causing backing up of water upstream or diverting it elsewhere. Any floodplain storage volume displaced by development is compensation is accommodated elsewhere within the site boundary on a 'level for level' basis.
- 5.5.5 Wherever possible it is desirable that new development actively reduces the existing runoff rates and as such, the flood risk created.

## 6 SURFACE WATER AND STORMWATER MANAGEMENT

### 6.1 Background and Policy Requirements

- 6.1.1 Generally, development increases the amount of impermeable area, consequently producing an increase in surface water runoff, unless suitable mitigation measures are incorporated. Future development requirements within Solihull therefore have the potential to increase the pluvial flood risk to the Borough and as such mitigation measures must be incorporated to ensure that surface water is managed sustainably.
- 6.1.2 Flood risk management policies require that the developments are 'safe', do not increase flood risk elsewhere and where possible reduce flood risk overall. In accordance with the NPPF PPG, the surface water drainage arrangements for any site should be such that the volumes and peak flow rates of surface water are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect. The SuDS approach includes measures to reduce surface water runoff at source, prevent pollution and provide a range of physical structures designed to receive the runoff. SuDS can also be designed to improve amenity and biodiversity in developed areas.
- 6.1.3 Under the FWMA (Section 5.2), LPAs have a leadership role (SAB) for local flood risk management, which includes ensuring that flood risk from all sources, including surface water runoff, is identified and managed as part of locally agreed work programmes. In addition, the Act requires developers to include sustainable drainage, where practicable, in new developments that are built to standards which reduce flood damage and improve water quality. The Act states that the adoption and maintenance of SuDS that benefit more than one property will be the responsibility of the SAB. However, as stated in Section 5.2 (FWMA) SAB duties are not yet live and currently under review by Government
- 6.1.4 Defra's National Standards for SuDS<sup>20</sup> were published for consultation in December 2011 and are likely to be finalised and released by Spring 2015. When released, the National Standards will set out the requirements for the design, construction and operation of SuDS for residential, commercial and industrial developments and redevelopments. The National Standards will encourage developers to consider drainage at the earliest stage of planning and take into account local flood risk, planning policies and climate change. It is thought that the National Standards will include principles and hierarchy of where water should end up.
- 6.1.5 A site-specific FRA is required by NPPF for all development proposals greater than 1 Hectare (Ha) to determine the impacts the development would have upon surface water runoff, regardless of the Flood Zone the development is located within. The use of SuDS should be encouraged in the form of a surface water management strategy as part of any strategic site masterplan for all development. It is recommended that SuDS options are investigated as part of a site specific FRA for any part development within the strategic allocation areas. Developer-funded strategic SuDS schemes may be appropriate if a large number of development sites are brought forward for development within the same catchment. Such schemes should be considered at an early stage in the planning process.
- 6.1.6 Geological ground conditions in the region have been considered to establish the potential feasibility of the use of SuDS at the Level 2 SFRA strategic proposed development sites. Sections 6.2, 6.3, 6.4 and 6.5 below identify sources of data available held by BGS and the Environment Agency that may impact the suitability of SuDS techniques and their location. Specific SuDS techniques suitable for use in Solihull are explained in Section 8.7.

### 6.2 BGS Bedrock and Superficial Deposits Maps

- 6.2.1 BGS data was reviewed to identify the bedrock and superficial deposits geological layers beneath each of the sites. The findings are presented for each site in Table 4-1 to Table 4-5.

<sup>20</sup> Defra. December 2011. *National Standards for sustainable drainage systems: Designing, constructing, operating and maintaining drainage for surface runoff*. Available at [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/82421/suds-consult-annexa-national-standards-111221.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/82421/suds-consult-annexa-national-standards-111221.pdf)

### 6.3 Groundwater Source Protection Zone Maps

6.3.1 There are specific areas where protection measures are needed for individual groundwater sources, such as springs, boreholes and wells. In these areas, the Environment Agency restrict activities that may pollute the groundwater resource (especially to major public water supplies or other potable water uses such as brewing) and defines SPZs to delineate the most critical areas requiring protection. This is relevant to SuDS as it can potentially restrict the use of infiltration based techniques such as soakaways.

6.3.2 Generally the closer a polluting activity or release is to a groundwater source the greater the risk of pollution. According to the Environment Agency, of the estimated 100,000 groundwater abstractions in England and Wales, there are nearly 2,000 major public and food production supply sources with bespoke SPZs. Most of these are sources producing more than 500,000 litres a day.

6.3.3 Each zone has three subdivisions for each source (Environment Agency, 1996). The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors as detailed below.

#### *SPZ 1 - Inner Protection Zone*

6.3.4 Any pollution that can travel to the borehole within 50 days from any point within the zone is classified as being inside this zone. This applies at and below the water table. This zone also has a minimum 50m protection radius around the borehole. These criteria are designed to protect against the transmission of toxic chemicals and water-borne disease.

#### *SPZ 2 - Outer Protection Zone*

6.3.5 The outer zone covers pollution that takes up to 400 days to travel to the borehole or 25% of the total catchment area, whichever area is the biggest. This travel time is the minimum amount of time that the Environment Agency estimate pollutants need to be diluted, reduced in strength or delayed by the time they reach the borehole.

#### *SPZ 3 – Source Catchment Protection Zone*

6.3.6 The total catchment (source catchment) is the total area needed to support removal of water from the borehole and to support any discharge from the borehole.

6.3.7 Prior to any SuDS techniques being developed within SPZ areas, consultation with the Environment Agency groundwater resources team is recommended to determine up-to-date and accurate information on local conditions.

#### *SPZ Data: Limitations*

6.3.8 As with the other data highlighted above, it is important to understand the main limitations associated with the SPZ dataset. These include:

- The maps use existing geological and soil maps and databases held by the BGS and the National Soil Research Institute and designed to be used at larger scales. They are therefore suitable for strategic planning purposes but not for site-specific assessment. Site specific assessment should be carried out in consultation with the Environment Agency's groundwater resources teams.
- As with all spatial geological data, there could be uncertainties in the boundaries and extents of SPZs shown on maps. Therefore detailed consultation should be undertaken with the Environment Agency for developments that overlap, abut or are adjacent to SPZs.

6.3.9 None of the five sites of interest for this Level 2 SFRA fall within or within close proximity to a groundwater SPZ. Parts of Meriden to the east of Solihull fall within Zones 1, 2 and 3 but due to their location they should not pose a constraint to development in principle. The Environment Agency is however likely to state that full foundation proposals would have to be approved to ensure any development in this area does not pose an unacceptable risk to groundwater.

## 6.4 Aquifer Designation Maps

- 6.4.1 Under the Environment Agency's Groundwater Protection Policy<sup>21</sup> an update to the Environment Agency's Groundwater Vulnerability dataset has been made. 'Aquifer Designation' maps were released by the Environment Agency in April 2010, developed taking into account the underlying BGS bedrock and superficial geology maps and are consistent with the Water Framework Directive.
- 6.4.2 Aquifers are defined as underground layers of water-bearing permeable rock or drift deposits from which groundwater can be extracted. The new designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.
- 6.4.3 The 'Bedrock Aquifer Designation' map on the Environment Agency's website<sup>22</sup> illustrate that the majority of Solihull lies above a 'Secondary B' aquifer designation, classed as:
- "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers".*
- 6.4.4 The eastern region of the Borough lies above a 'Principal Aquifer, defined as:
- "...layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer".*
- 6.4.5 Some small pockets of the Borough, primarily in the south and east, lie above 'Secondary A' aquifer. Secondary A aquifers are classed as:
- "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers".*
- 6.4.6 An area north of Knowel/east of Copt Heath lies above a 'Secondary undifferentiated' aquifer. Secondary (undifferentiated) aquifers are:
- "assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type".*
- 6.4.7 The 'Superficial Aquifer Designation' map on the Environment Agency's website<sup>22</sup> illustrates that various areas including along the line of Main Rivers (River Cole and River Blythe in particular) in Solihull lie above a 'Secondary A' aquifer designation. Other areas are underlain with superficial layers designated as 'Secondary (undifferentiated)' aquifers. The findings specific to each Level 2 SFRA site are presented in Table 4-1 to Table 4-5.
- 6.4.8 Unless there is site specific information to the contrary, the following default position of the Environment Agency applies in regard to their Groundwater Protection Policy:
- if no superficial (drift) aquifers are shown (un-coloured areas), bedrock designation will be used,
  - in areas where the bedrock designation shows unproductive strata (the un-coloured areas) the superficial (drift) designation will be used, and
  - in all other areas, the more sensitive of the two designations will be used (e.g. if secondary drift overlies principal bedrock, an overall designation of Principal will be adopted).

<sup>21</sup> Environment Agency, 2008. Groundwater Protection Policy.

<sup>22</sup> Environment Agency. 2014. 'Aquifer Designation' Maps. Available at <http://maps.environment-agency.gov.uk>

## 6.5 Nitrate Vulnerable Zones

- 6.5.1 The Environment Agency have produced mapping<sup>23</sup> that shows areas across the United Kingdom that have been designated as a Nitrate Vulnerable Zone (NVZ) under the Nitrates Directive (1991)<sup>24</sup> from 2013. The Nitrates Directive is intended to reduce water pollution caused by nitrates from agricultural sources.
- 6.5.2 The Environment Agency has identified surface and groundwaters that are or could be high in nitrate from agricultural sources. All land draining to that identified water is therefore designated as a NVZ. Within these areas farmers are required to observe an action programme of measures which include restricting the timing and application of fertilisers and manure, and keeping accurate records.
- 6.5.3 The entire Borough of Solihull has been highlighted as a surface water NVZ identified as Zone 308. Parts of Meriden to the east of the Borough are located within a Groundwater NVZ identified as Zone 36.
- 6.5.4 Any boreholes, water wells or abstraction points should be identified and this information taken into account at the design process for each of the strategic proposed development sites. Nitrate levels in the local soils or nearby water-bodies will impact upon which SuDS can be used for specific sites. If local soil is contaminated then a lined system would be required which should prevent contamination to areas that require protection. Where source control SuDS are considered appropriate and runoff is likely to be heavily contaminated then runoff should be treated by a proprietary device. It is recommended that a GI is undertaken for each site to determine the local conditions.

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<sup>23</sup> Environment Agency. 2014. 'Nitrate Vulnerable Zones' Maps. Available at <http://maps.environment-agency.gov.uk>

<sup>24</sup> European Commission, 1991. *Directive 1991/676/EEC. Nitrates Directive.*

## 7 CRITICAL DRAINAGE AREAS AND SWMP REQUIREMENT

### 7.1 Determination of Critical Drainage Areas

7.1.1 It is recommended in NPPF that CDAs are investigated to determine the requirements for a SWMP as part of a Level 2 SFRA. A Level 2 SFRA should determine in detail areas where historical incidents of surface water and sewer flooding (identified in the Level 1 SFRA with any new data) coincide with areas of high flooding probability in the EA's uFMfSW.

### 7.2 Requirements for a SWMP

7.2.1 As identified in the SWMP Technical Guidance<sup>25</sup>, there are some common criteria which may help identify the need for an SWMP:

- Critical drainage areas identified as part of a Level 2 SFRA, and hence the need for a SWMP.
- Future urbanisation/redevelopment – new home building in urban extensions or as part of regeneration presents a challenge to existing drainage systems but can also become an opportunity to address long-standing problems.
- Evidence of surface water flooding history – this is one of the most reliable indicators of high risk for future flooding. Information on previous flooding is often collated in an SFRA or CFMP, but is also available from local authorities, water companies, the Environment Agency and the community.
- Known degree of drainage system interaction – where the operation of local drainage system is known to be complicated by interactions between systems, solutions have to involve a partnering approach.

7.2.2 A SWMP could be undertaken and provide more detailed information as to the pluvial flood risk across Solihull. Pluvial modelling undertaken as part of a SWMP could identify critical drainage areas (CDA) and pluvial flood risk hotspots within these and could also examine the influence of ordinary watercourses across the Borough in more detail. It has however become common practice since the NPPF PPG was published that SWMPs themselves define CDAs in detail.

7.2.3 The PFRA already identified multiple potential CDAs within Solihull, concentrated within the west. A selection of these were subsequently modelled as part of a Local Flood Risk Management Plan for the River Cole<sup>26</sup>. This report however does not cover any of the Level 2 SFRA study area sites.

7.2.4 Considering the common criteria above, and having reviewed the historical flooding incident data and uFMfSW provided by the SMBC and the EA, no critical drainage areas were identified within the Level 2 SFRA study area sites. It is therefore considered that an SWMP is not required for the Level 2 SFRA site areas of Solihull, for the following reasons:

- Existing rural nature of the majority of the Level 2 SFRA sites, and
- Lack of significant known surface water and/or sewer flooding issues in the vicinity of the sites.

7.2.5 Of the potential development sites, any identified as having a risk of surface water flooding have been addressed by the preparation of a series of policies and guidance to deal with any proposed development for the areas, including FRA guidance, mitigation options and SuDS guidance. These policy statements will be aimed at avoiding and reducing any associated flood risk.

<sup>25</sup> Defra. 2010. *Surface Water Management Plan Technical Guidance*.

<http://archive.defra.gov.uk/environment/flooding/documents/manage/surfacewater/swmp-guidance.pdf>

<sup>26</sup> Atkins. 2010. *River Cole Local Flood Risk Management Plan – Assessment of Flood Risk Report*.

## 8 SITE SPECIFIC FLOOD RISK ASSESSMENT GUIDANCE

### 8.1 Overview

- 8.1.1 A site-specific FRA should identify and assess the risks of all forms of flooding to and from proposed development and demonstrate how these flood risks will be managed so that the development remains safe throughout its lifetime, taking climate change into account.
- 8.1.2 In accordance with the policies set out in the NPPF any development will not add to and should where practicable reduce flood risk. The future users of the development must not be placed in danger from flood hazards and should remain safe throughout the lifetime of the plan or proposed development and land use. The NPPF PPG provides a 'Site-specific FRA Checklist' detailing the required contents for inclusion in an FRA to help developers and applicants to prepare an appropriate, site-specific FRA in accordance with the PPG.
- 8.1.3 As set out in the NPPF development will only be considered in flood risk areas where informed by a site-specific FRA. Site-specific FRA's are required for all development in Flood Zone 2 and Flood Zone 3 and for sites greater than 1 ha in Flood Zone 1, in accordance with Table 2 and Footnote 20 of the NPPF. These will be reviewed either by the LPA or the Environment Agency depending upon the scale and nature of the proposed development (see advice already proposed in Section 9 of the Level 1 SFRA).

### 8.2 Level 3 – Detailed / Site-Specific Flood Risk Assessment

- 8.2.1 Where the quality and/or quantity of information for any of the flood sources affecting a site is insufficient to enable a robust assessment of the flood risks, further investigation will be required. For example it is generally considered inappropriate to base an FRA for a residential care home at risk of flooding from fluvial sources on Flood Zone maps alone. In such cases the results of detailed hydraulic modelling are preferable to ensure details of flooding mechanisms and the onset of flooding is fully understood and that the proposed development incorporates appropriate mitigation measures.
- 8.2.2 Developers should also identify the residual risk as part of a site specific detailed FRA. Such assessment should be appropriate to the scale and nature of the proposed development and flood risk. Should the potential impact be unacceptable, mitigation should be provided. Depth hazard mapping, carried out as part of this SFRA should be reviewed and where necessary be expanded on as part of any site-specific FRA.
- 8.2.3 At all stages, the LPA, LLFA and where necessary the Environment Agency, statutory sewerage/water undertaker and / or Internal Drainage Board (IDB) should be consulted to ensure the site-specific FRA provides the necessary information to fulfil the requirements for planning applications.
- 8.2.4 If any new data arises that suggests there may be a flood risk issue at a site, an FRA should be undertaken regardless of the size of development.
- 8.2.5 The NPPF PPG states that when considering safety, specific local circumstances need to be taken into account, including:
- the characteristics of a possible flood event, e.g. the type and source of flooding and the frequency, depth, velocity and speed of onset;
  - the safety of people within a building if it floods and also the safety of people around a building and in adjacent areas, including people who are less mobile or who have a physical impairment. This includes the ability of residents and users to safely access and exit a building during a design flood and to evacuate before an extreme flood;
  - the structural safety of buildings, and;
  - the impact of a flood on the essential services provided to a development.
- 8.2.6 A number of measures can be used to manage flood risk including:

- Use local topography to guide water away from proposed development and into surface water drainage systems (Section 8.3);
- Designing buildings with flood resilience and resistance measures such as raising floor levels above the flood water inundation level (Section 8.4 and Section 8.5);
- Use SuDS where possible to reduce runoff rates discharging to local drainage systems (Section 8.6 and 8.7);
- Flood warning (Section 8.8) and evacuation plans (Section 8.9); and
- Emergency access and egress (Section 8.10).

### 8.3 Site Layout, Land Use and Vulnerability

- 8.3.1 The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas. Development should be sequentially allocated within the site boundary to areas firstly within Flood Zone 1 (<0.1% AEP of flooding, low probability) and then Flood Zone 2 (>1% AEP <=0.1% AEP of flooding, medium probability) where 'less vulnerable' development uses would be more appropriate. Residential developments ('more vulnerable') should be restricted to areas at low hazard and parking, open space or proposed landscaped areas can be placed on lower ground with a higher probability of flooding
- 8.3.2 Should development pressure create a need to develop within the areas within Flood Zone 3 (1% AEP and 1% AEP +CC) appropriate minimum floor levels to adopt in agreement with the Environment Agency should be determined. It is required that any flood volume displaced as a result of development within the entire Flood Zone 3 plus an allowance for climate change envelope (encapsulating Flood Zones 3a (1% AEP) and 3b (5% AEP)) be compensated for elsewhere within the site boundary on a 'level for level' and 'volume for volume' basis. Any proposed layout and location for such compensation should take into account the flow routing to ensure adequate conveyance.
- 8.3.3 Appropriate mitigation measures should be incorporated that do not increase the risk of flooding to surrounding areas, and where opportunity exists, aim to reduce flood risk to surrounding areas.
- 8.3.4 In addition to mitigating the impact of any fluvial flows displaced as described above, consideration should be given to the impact of any development on pluvial flow routes and areas susceptible to ponding (see Appendix A Figure A-2) informed by a review of the local topography, geology and any structures that may influence the movement of water over the surface. Following the sequential approach to the layout of buildings, and provision of SuDS (see Sections 8.6 and 8.7) will assist in mitigating any increase in risk from surface water to surrounding areas.
- 8.3.5 Structures such as (bus, bike) shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground.

### 8.4 Building Design

#### *Finished Floor Levels*

- 8.4.1 Where developing in flood risk areas is unavoidable, the most common method of mitigating flood risk to people, particularly with 'more vulnerable' (residential) land uses, is to ensure habitable floor levels are raised 600 mm above the 1 in 100 (1% annual exceedance probability) plus climate change flood water level derived for the immediate vicinity within the site (i.e. relative to the extent of a site along a watercourse as flood levels are likely to vary with increasing distance downstream).
- 8.4.2 The Environment Agency's requirements for a freeboard for finished floor levels within 'less vulnerable' commercial and industrial units vary, depending upon the proposals. For such land uses, finished floor levels may not be required to be raised. However, it is strongly recommended that internal access is provided to upper floors to provide safe refuge in a flood event (it is appreciated that this may not always be possible in heavily urbanised regions of the study area where commercial properties are to be located underneath privately owned residential accommodation).

- 8.4.3 Schools and hotels are classed as ‘more vulnerable’ land uses, however, should it not be viable to raise finished floor levels internal access to higher floors must therefore be provided to give safe refuge during times of flood.
- 8.4.4 Further consultation with the Environment Agency will therefore be required during the undertaking of any detailed FRA. Where internal access to higher floors is provided for either ‘less vulnerable’ or ‘more vulnerable’ proposed land uses, the associated plans showing this should be included within any site specific FRA.
- 8.4.5 In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Environment Agency should be approached to discuss options for a reduction in the minimum internal ground floor levels provided flood proofing (resilience) measures (Section 8.5) are implemented up to an agreed level. There are also circumstances where flood proofing (resilience) measures should be considered first.
- 8.4.6 It is also therefore advised that the adjacent finished external ground levels are also ensured a sufficient distance below the recommended internal ground floor levels to mitigate against any localised external flooding.

**8.5 Flood Resilience and Resistance Measures**

- 8.5.1 Within the design of buildings in areas where the probability of flooding is low or in areas where flood risk management measures have been put in place, guidance has been outlined by the Department of Communities and Local Government in ‘Improving the Flood Performance of New Buildings’<sup>27</sup>.
- 8.5.2 Flood proofing is a technique by which buildings are designed to withstand the effects of flooding. There are two main categories of flood proofing; dry proofing and wet proofing. Dry proofing methods are designed to keep water out of the building, and wet proofing methods are designed to improve the ability of the property to withstand the effects of flooding once the water has entered the building.
- 8.5.3 Further guidance is also provided in the CIRIA Research Project 624 ‘Development and Flood Risk: Guidance for the Construction Industry’<sup>28</sup>. Table 8-1-1 summarises recommendations made within Table A3.6 of the report for flood proofing measures which can be incorporated within the design of buildings (subject to compliance with Building Regulations).

**Table 8-1-1 Flood Proofing Considerations**

Feature	Consideration to improve Flood Proofing
External Walls	Careful consideration of materials: use low permeability materials to limit water penetration if dry proofing required. Avoid using timber frame and cavity walls. Consider applying a water resistant coating. Provide fittings for flood boards or other temporary barriers across openings in the walls (dry proofing).
Internal Walls	Avoid use of gypsum plaster and plasterboard; use more flood resistant linings (e.g. hydraulic lime, ceramic tiles). Avoid use of stud partition walls.
Floors	Avoid use of chipboard floors. Use concrete floors with integrated and continuous damp proof membrane and damp proof course. Solid concrete floors are preferable; if a suspended floor is to be used, provide facility for drainage of sub-floor void. Use solid insulation materials.
Fitting, Fixtures and Services	If possible, locate all fittings, fixtures and services above design flood level. Avoid chipboard and MDF. Consider use of removable plastic fittings. Use solid doors treated with waterproof coatings. Avoid using double-glazed window units that may fill with flood water. Use solid wood staircases. Avoid fitted carpets. Locate electrical, gas and telephone equipment and systems above design flood level. Fit anti-flooding devices to drainage systems.

<sup>27</sup> Department for Communities and Local Government. 2007. ‘Improving the Flood Performance of New Buildings – Flood Resilient Construction’, Defra: London. Available at: <https://www.gov.uk/government/publications/flood-resilient-construction-of-new-buildings>

<sup>28</sup> CIRIA. 2004. ‘Research Project 624 ‘Development and Flood Risk: Guidance for the Construction Industry’. Available at [www.ciria.org/](http://www.ciria.org/)

## 8.6 Sustainable Drainage Systems (SuDS)

- 8.6.1 In accordance with the NPPF PPG suitable surface water mitigation measures are incorporated into any development plans in order to reduce and manage surface water flood risk to, and posed by the proposed development. This should ideally be achieved by incorporating SuDS.
- 8.6.2 In accordance with the SMBC Local Plan Policy P11 (Section 5.4), a site specific FRA should demonstrate that post-development surface water discharge rates and volumes for any proposals greater than 1 Ha should be equivalent to surface water discharges arising from the area prior to any development i.e. the site specific greenfield runoff rate.
- 8.6.3 Contact should be made with ST at an early stage in the planning process for these areas in order to discuss and investigate improvement requirements or options for the local drainage network.
- 8.6.4 The key aim of SuDS is to reduce runoff by integrating storm water controls throughout a site in small, discrete units. SuDS should, where possible, mimic the natural drainage process and, in addition to controlling water quantity, should seek to maintain or improve water quality, amenity value and biodiversity. Through effective control of runoff at the source, the need for large flow attenuation and flow control structures should be minimised.
- 8.6.5 SuDS can be broadly split into three types: source, site and regional control. Source control methods aim to control runoff at or close to the source e.g. green roofs, rainwater harvesting. Site control is the management of runoff from several areas in the local area e.g. routing water to detention basins, whilst regional control involves the management of runoff from a site or a number of sites which typically drains to a balancing pond or wetland.
- 8.6.6 As part of any SuDS scheme, consideration should be given to the long-term maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. Any proposed drainage mechanism should be agreed through consultation with the SAB or until arrangements for SABs are finalised, SMBC who became the LLFA for Solihull in April 2011.
- 8.6.7 SuDS measures that may be suitable for use in Solihull are discussed in more detail below.

## 8.7 SuDS Use in Solihull

- 8.7.1 Given the greenfield nature of the proposed sites in Solihull, there are significant opportunities for the development sites to adopt source control and site measures that are consistent with an overarching regional SuDS policy.
- 8.7.2 Table 8-2 shows a summary of likely SuDS techniques detailed in Section 10.2 of the Level 1 SFRA that could be utilised by SMBC and their sustainability benefits.
- 8.7.3 Site geology should be taken into account when deciding on suitable SuDS measures. Some SuDS systems rely on infiltration which in areas of low permeability may be technically unviable. If SuDS using infiltration are to be used, permeability tests should therefore be carried out to establish infiltration rates.
- 8.7.4 Any surface water management system should be implemented in accordance with relevant policy and guidance such as NPPF, National SuDS Working Group (2004), BRE365, CIRIA C522 for SUDS, CIRIA 523 (SuDS Best Practice Manual) and CIRIA C697 (the SUDS Manual).

**Table 8-2: Summary of SuDS techniques and their suitability to meet SMBC’s sustainability aims for water management**

Management Train		Component	Description	Water Quantity	Water Quality	Amenity Biodiversity
	Prevention	Green roofs	Layer of vegetation or gravel on roof areas providing absorption and storage.	●	●	●
		Rainwater harvesting	Capturing and reusing rainwater for domestic or irrigation uses.	●	○	○
		Permeable pavements	Infiltration through the surface into underlying layer.	●	●	○
		Filter drains	Drain filled with permeable material with a perforated pipe along the base.	●	●	×
		Infiltration trenches	Similar to filter drains but allows infiltration through sides and base.	●	●	×
		Soakaways	Underground structure used for storage and infiltration.	●	●	×
	Source	Bio-retention areas	Vegetated areas used for treating and storing runoff prior to discharge into receiving water or infiltration	●	●	●
		Swales	Grassed depressions, provides temporary storage, conveyance, treatment and possibly infiltration.	●	●	○
		Sand filters	Provides treatment by filtering runoff through a filter media consisting of sand.	●	●	×
		Regional Site	Basins	Dry depressions outside of storm periods, provides temporary attenuation, treatment and possibly infiltration.	●	●
Ponds	Designed to accommodate water at all times, provides attenuation, treatment and enhances site amenity value.		●	●	●	
Wetland	Similar to ponds, but are designed to provide continuous flow through vegetation.		●	●	●	

**8.8 Flood Warning and Flood Alert Areas**

8.8.1 Ensuring people in areas of flood risk are aware of potential flooding is key to ensuring they are prepared, facilitating the protection of property and evacuation where necessary.

8.8.2 The Environment Agency operates a flood warning and flood alert service for defined areas at risk of fluvial and tidal flooding; Flood Alert Areas and Flood Warning Areas.

- 8.8.3 The flood warning service currently consists of three stages:
- **Flood Alert** - flooding is possible and that you need to be prepared;
  - **Flood Warning** - flooding is expected and that you should take immediate action. Action should be taken when a flood warning is issued and not wait for a severe flood warning; and
  - **Severe Flood Warning** - there is severe flooding and danger to life. These are issued when flooding is posing significant risk to life or disruption to communities.

8.8.4 Each flood warning code gives an indication of the expected level of danger. Although some members of the public find Flood Alerts useful, they are predominantly targeted towards professional partners, alerting them to expected flooding of low lying land and roads. Flood Warnings and Severe Flood Warnings are more useful for the public, alerting them to expected property flooding.

8.8.5 All stages of the flood warning are disseminated via the ‘Floodline Warnings Direct’<sup>29</sup>, which is a free service that provides warnings to registered customers by telephone, mobile, email, SMS text

<sup>29</sup> Environment Agency. 2014. Flood Warnings Direct. Available at <https://fwd.environment-agency.gov.uk/app/olr/home>

message and fax. Local radio, TV, loudhailers, sirens and Floodline are also used to deliver flood warning messages. The Floodline number is 0845 988 1188, and it is kept up to date with the Environment Agency 's latest flooding information. More detailed information on the likely extent and time scale of these warnings can be obtained by request from the Environment Agency, by their 'Quickdial' recorded information service, or via their website.

8.8.6 The Flood Warning Areas and Flood Alert Areas present within the study area of this Level 2 SFRA are as follows (see Figure A-4 at Appendix A):

- Flood Alert Areas:
  - 033WAF301 - River Rea and River Cole to the north west
  - 033WAF302 - River Blythe across the central and southern parts of Solihull
  - 033WAF303 - River Tame across the very north
- Flood Warning Area:
  - Canolbarth for the River Rea, River Cole, River Tames and River Blythe.

8.8.7 Where a particular site lies within an area not currently eligible to receive flood warnings, it can be registered with the local Environment Agency office as an 'area of interest' in order to receive such warnings. The flood warnings are then able to be provided by the service via mobile, telephone, fax or pager.

8.8.8 For any proposed commercial or industrial developments within a designated floodplain, or those providing a service to vulnerable groups such as elderly care homes or hospitals, a system for monitoring flood warnings should be developed with designated responsible persons able to monitor and disseminate the warnings. This will provide more time to enable emergency access and egress of staff or residential occupants away from the local area which may become flooded during a flood event (including routes for egress) prior to inundation. The need for, and feasibility of flood warning systems for an individual development should be considered and discussed with the Environment Agency with an FRA.

8.8.9 They should also enable sufficient time to implement protection measures for any commercial goods or personal belongings on site through sealing all external doors to prevent flood inflow into such buildings as a precaution.

## 8.9 Evacuation Plans

8.9.1 The exact nature of any emergency plans and procedures should be determined from the results obtained through the detailed FRAs for the individual sites and may be needed in conjunction with other mitigation measures, such as a formal private flood warning system triggered by the Environment Agency's flood warnings and hydrometric monitors. They would need to contain details of how and by whom flood warnings are to be monitored, when and how evacuations are to be instigated, how the proposed access routes are to be maintained and what provisions are to be managed for occupiers of the site.

8.9.2 Where there are exceptional circumstances in which development is allowed, which is reliant on evacuation, the LPA will need to assess whether the proposals are acceptable to their own emergency planner and the local emergency services. It is not the remit of the Environment Agency to make recommendations on this matter.

## 8.10 Emergency Access and Egress

8.10.1 Emergency access and egress is required to enable the evacuation of people from developments and also to provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood.

8.10.2 An emergency access and egress route is a route that is 'safe' for use by occupiers without the intervention of the emergency services or others. A route can only be completely 'safe' in flood risk terms if it is dry at all times.

- 8.10.3 For developments located in areas at flood risk, the Environment Agency consider 'safe' access and egress to be in accordance with 'FRA Guidance for New Developments FD2320'<sup>30</sup>, where the requirements for safe access and egress from new developments are as follows in order of preference:
- Safe, dry route for people and vehicles,
  - Safe, dry route for people,
  - If a dry route for people is not possible, a route for people where the flood hazard (in terms of depth and velocity of flooding) is low and should not cause risk to people, and
  - If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles.
- 8.10.4 For commercial development ('less vulnerable') it is considered that dry access and egress from the site will be desirable during times of extreme floods. For all new residential development ('more vulnerable'), it is considered that dry access and egress will be essential during times of extreme floods from each residential unit to an area outside of the floodplain. New properties within a 'dry island' of the fluvial floodplain will also require dry access due to the disruption to essential services (gas, water, etc.) that would be experienced during a flood event.
- 8.10.5 It is necessary to ensure that proposed roads levels are such that emergency access and egress routes are maintained or where possible constructed to a level agreed with the Environment Agency. This can significantly reduce the risk of the proposed development becoming inundated by flooding.
- 8.10.6 Details of how this will be achieved should be clearly described in site-specific FRAs. This should include:
- A review of any detailed river models (where available),
  - A review of flood extents from broad-scale modelling, and
  - Comparison of flood extents/levels with local ground levels from topographical survey or digital elevation models (DTM/DSM).
- 8.10.7 A preliminary review of the potential for safe, dry access and egress to/from the proposed development sites was undertaken as part of this Level 2 SFRA. This review identified the potential for safe dry access and egress to/from each of the sites via roads not located within fluvial Flood Zones 2 or 3. However, the assessment of feasible access and egress routes will require consideration of all potential sources of flooding (including the potential for mechanisms such as ponding of surface water) relative to the proposed layout and design of the road connections as part of the site-specific FRAs.

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<sup>30</sup> DEFRA / Environment Agency. October 2005. *Flood Risk Assessment Guidance for New Development. R&D Technical Report FD2320/TR2*. Available at [http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM\\_Project\\_Documents/FD2320\\_3364\\_TRP\\_pdf.sflb.ashx](http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2320_3364_TRP_pdf.sflb.ashx)

## **9 CONCLUSIONS**

- 9.1.1 In accordance with NPPF, a specific policy on flood risk was included in the adopted Local Plan to ensure that:
- Development is located in the lowest flood risk areas,
  - New development is flood-proofed to a satisfactory degree and does not increase flood risk elsewhere, and
  - Surface water is managed effectively on site.
- 9.1.2 To ensure a holistic approach to flood risk management and that flooding is taken into account at all stages of the planning process, the findings of this report should be read in conjunction with the adopted Local Plan for SMBC and in conjunction with the Level 1 SFRA which provides additional mapping, guidance and recommendations.
- 9.1.3 Recommendations and policies have been presented above in Section 4 for the five individual proposed development areas within Solihull.

**APPENDIX A – LEVEL 2 SFRA MAPPING**

Environment Agency Flood Zones (Undefended) (Fluvial)	A-1
Environment Agency uFMfSW (Pluvial) Risk Classifications	A-2
Environment Agency AStGWF (Groundwater)	A-3
Environment Agency Flood Warning Areas and Flood Alert Areas	A-4
Reported Historic Flooding Incidents	A-5A
Severn Trent Reported Historic Sewer Flooding Incidents	A-5B

**APPENDIX B – ENVIRONMENT AGENCY CORRESPONDENCE**

20-02-2013 Letter to SMBC

02-05-2014 Letter to SMBC

17-11-2014 Letter to SMBC

**APPENDIX C – CHELMSLEY WOOD MODELLING STUDY OUTPUT**

Figure C-1 - Flood\_Contour\_Plan\_(Pike Drive, Chelmsley Wood)

Figure C-2 - Flood\_Contour\_Plan\_(Conway Road, Fordbridge)