Wolverhampton City Council

Preliminary Flood Risk Assessment

Final Report
June 2011
Revision Schedule

Preliminary Flood Risk Assessment
Final
June 2011

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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ASTSWF</td>
<td>Areas Susceptible to Surface Water Flooding</td>
</tr>
<tr>
<td>CFMP</td>
<td>Catchment Flood Management Plan</td>
</tr>
<tr>
<td>CLG</td>
<td>Communities and Local Government</td>
</tr>
<tr>
<td>Defra</td>
<td>Department for Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>DG5</td>
<td>Sewer flooding register</td>
</tr>
<tr>
<td>FMfSW</td>
<td>Flood Map for Surface Water</td>
</tr>
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<td>HA</td>
<td>Highways Agency</td>
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<tr>
<td>IDB</td>
<td>Internal Drainage Board</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>LA</td>
<td>Local Authority</td>
</tr>
<tr>
<td>LDDs</td>
<td>Local Development Documents</td>
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<tr>
<td>LDF</td>
<td>Local Development Framework</td>
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<tr>
<td>LLFA</td>
<td>Lead Local Flood Authority</td>
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<tr>
<td>NE</td>
<td>Natural England</td>
</tr>
<tr>
<td>PPS</td>
<td>Planning Policy Statement</td>
</tr>
<tr>
<td>SAC</td>
<td>Special Area for Conservation</td>
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<tr>
<td>SFRA</td>
<td>Strategic Flood Risk Assessment</td>
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<td>SPA</td>
<td>Special Protection Area</td>
</tr>
<tr>
<td>SPD</td>
<td>Supplementary Planning Document</td>
</tr>
<tr>
<td>ST</td>
<td>Severn Trent Water</td>
</tr>
<tr>
<td>SSSI</td>
<td>Site of Special Scientific Interest</td>
</tr>
<tr>
<td>SUDS</td>
<td>Sustainable Drainage Systems</td>
</tr>
<tr>
<td>SWMP</td>
<td>Surface Water Management Plan</td>
</tr>
<tr>
<td>The Act</td>
<td>The Flood and Water Management Act 2010</td>
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<td>The Regulations</td>
<td>The Flood Risk Regulations 2009</td>
</tr>
<tr>
<td>UKCIP</td>
<td>United Kingdom Climate Impacts Programme</td>
</tr>
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<td>WAG</td>
<td>Welsh Assembly Government</td>
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<td>WCC</td>
<td>Wolverhampton City Council</td>
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Executive Summary

The Preliminary Flood Risk Assessment (PFRA) provides a high level overview of flood risk from local sources.

The Environment Agency (EA) has identified ten Indicative Flood Risk Areas nationally, one of which is located in the West Midlands and covers 95.96% of the administrative area of Wolverhampton. Wolverhampton City Council (WCC), as a designated Lead Local Flood Authority (LLFA), is obliged to undertake a Preliminary Flood Risk Assessment (PFRA) in order to bring together flood risk information from all available sources.

PFRA’s are intended to provide a high level overview of flood risk from local sources, including surface water, groundwater, ordinary watercourses and canals. As such, WCC is required to:

1. Prepare a preliminary assessment report (this report).
2. Identify significant flood risk areas.
4. Prepare flood risk management plans for each identified flood risk area (by 2015).

National scale modelling by the EA has indicated that approximately 8,700 properties within Wolverhampton could be at risk of significant flooding as a result of very heavy rainfall. This PFRA has not amended the national Indicative Flood Risk Area for Wolverhampton.

However, analysis of historic flood events across Wolverhampton shows that there have been no recorded flood events with ‘significant harmful consequences’ (defined as more than 30 properties affected). Previous known flooding locations have largely been addressed by sewer improvements or better maintenance regimes to reduce the risk of future flood events.

Work will continue, through the Wolverhampton Flood Risk Partnership and development of the Surface Water Management Plan, to identify areas within Wolverhampton that are at risk of flooding and to prepare plans to mitigate the risk.
1 Introduction

1.1 Preliminary Flood Risk Assessment

This document reports the findings of research undertaken by Wolverhampton City Council (WCC) with support from URS/Scott Wilson towards the preparation of a Preliminary Flood Risk Assessment (PFRA) for WCC’s administrative area.

The key drivers behind the PFRA are two pieces of new legislation; the Flood Risk Regulations 2009 (The Regulations) which came into force on the 10th December 2009, and the Flood & Water Management Act (FWMA), which gained Royal Assent on the 8th April 2010, many actions from which also contribute to this PFRA. Under these pieces of legislation, all Unitary Authorities and County Councils (including WCC), are designated as Lead Local Flood Authorities (LLFAs), and have formally been allocated key responsibilities with respect to local flood risk management. A full description of these responsibilities is provided in Chapter 2.

The purpose of ‘The Regulations’ was to transpose the EC Floods Directive (Directive 2007/60/EC on the assessment and management of flood risk) into domestic law in England and Wales and to implement its provisions. In particular it places duties on LLFAs to prepare a number of documents including:

- Preliminary Assessment Reports.
- Maps to show identified Flood Risk Areas.
- Flood Hazard Maps and Flood Risk Maps.
- Flood Risk Management Plans for identified Flood Risk Areas.

An excerpt from ‘The Regulations’ regarding the duty of LLFAs to prepare PFRAs is shown in Figure 1-1.
Table 1-1 shows the elements of work required of WCC under ‘The Regulations’, along with the timescales for delivery. ‘The Regulations’ establish four stages of activity within a six year flood risk management cycle. The first two stages are covered by the preparation of this PFRA.

**Table 1-1: Elements of work required under the Flood Risk Regulations (2009)**

<table>
<thead>
<tr>
<th>Timescale for Delivery</th>
<th>Stage</th>
<th>Products Required</th>
</tr>
</thead>
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<tr>
<td>22nd June 2011</td>
<td>Prepare Preliminary Assessment Report</td>
<td>The PFRA should focus on local flood risk from surface water, groundwater, ordinary watercourses and canals</td>
</tr>
<tr>
<td>22nd June 2011</td>
<td>Identify Flood Risk Areas</td>
<td>Flood Risk Areas are areas of significant risk identified on the basis of the findings of the PFRA, national criteria set by the UK Government Secretary of State and guidance provided by the Environment Agency (EA)</td>
</tr>
<tr>
<td>22nd June 2013</td>
<td>Prepare Flood Hazard Maps and Flood Risk Maps for each Flood Risk Area</td>
<td>Used to identify the level of hazard and risk of flooding within each Flood Risk Area to inform Flood Risk Management Plans</td>
</tr>
<tr>
<td>22nd June 2015</td>
<td>Prepare Flood Risk Management Plans for each Flood Risk Area</td>
<td>Plans setting out risk management objectives and strategies for each Flood Risk Area</td>
</tr>
</tbody>
</table>

The scope of this PFRA is to consider past flooding and possible future flooding from the following local flood sources:

- Surface water.
- Groundwater.
- Ordinary watercourses.
- Canals.

Flooding associated with the sea, main rivers and large raised reservoirs are the responsibility of the EA and do not need to be assessed as part of the PFRA (cf. Figure 1-1), unless there is an interaction from one of the sources listed above.
1.2 Aims and Objectives

The aim of this PFRA was to undertake a high level screening exercise to identify flood risk areas within Wolverhampton where the risk of surface water, groundwater, ordinary watercourse or canal flooding is significant, and to support local flood risk management strategies by the production of maps and management plans. This was achieved by investigating information on past floods and the potential consequences of future floods.

The key objectives can be summarised as follows:

- Identify relevant partner organisations involved in future assessment of flood risk and summarise means of future and ongoing stakeholder engagement.
- Describe arrangements for partnership and collaboration for ongoing collection, management, assessment and storage of flood risk data and information.
- Provide a summary of the systems used for data sharing and storing, and provision for quality assurance, security and data licensing arrangements.
- Summarise the methodology adopted for the PFRA with respect to data sources, availability and review procedures.
- Review the provisional national assessment of indicative Flood Risk Areas provided by the EA and provide explanation and justification for any amendments to the Flood Risk Areas.
- Assess historic flood events within the study area from local sources of flooding (from surface water, groundwater, ordinary watercourses and canals), and the consequences and impacts of these events.
- Establish an evidence base of historic flood risk information, which will be built on in the future and used to support and inform the preparation of Wolverhampton's Local Flood Risk Strategy.
- Assess the potential harmful consequences of future flood events within the study area.

1.3 Study Area

The administrative area of WCC covers 55.98km², and has a population of 236,000 (ONS, 2007). The area is heavily urbanised, resulting in a loss of greenfield infiltration capacity and a high proportion of watercourses being culverted. The total lengths of different types of watercourses within the administrative area of WCC are summarised in Table 1-2 (overleaf).

Wolverhampton lies on the western side of the Birmingham plateau approximately 120m above sea level and land elevations fall away to the east and west. Most of the administrative area lies in the headwaters of the Stour and Tame catchments (western and eastern parts, respectively), whilst the northern edge of the administrative area drains into the River Penk. There are relatively low-lying areas around The Lunt in east Wolverhampton, Pendeford and Fordhouses in the northeast, and Castlecroft in the east.

Smestow Brook, Darlastow Brook and the Tame Tunnel (Wolverhampton Arm) are classified as Main Rivers within the administrative area of WCC, and the sources of the River Penk and River Tame (both tributaries of the River Trent) are also in Wolverhampton.

There are a number of ordinary watercourses within the city, many of which are extensively culverted, including Waterhead Brook, Wadden's Brook, Darlaston Brook, Penn Brook.
There is an extensive canal network within Wolverhampton including the Birmingham Main Line Canal, the Staffordshire and Worcestershire Canal, Walsall Canal, the Shropshire Union Canal and the Wyrley and Essington Canal.

Wolverhampton is underlain by a complex geology of permeable sandstones and coal measures and impermeable dolerite of the Carboniferous and Triassic eras.

Table 1-2: Lengths of watercourses within Wolverhampton

<table>
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<tr>
<th>Total Channel Lengths within WCC Boundary (km)</th>
<th>Main River</th>
<th>Ordinary Watercourse</th>
<th>Culverted Watercourses</th>
<th>Canals</th>
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<td>8.9</td>
<td>10.5</td>
<td>37.2</td>
<td>28.4</td>
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2 Lead Local Flood Authority Responsibilities

2.1 Introduction

The preparation of a PFRA is just one of several responsibilities of LLFAs under the new legislation. This section provides a brief overview of other responsibilities WCC is obliged to fulfil in its role as a LLFA.

2.2 Coordination and Communication of Flood Risk Management

In his review of the summer 2007 flooding, Sir Michael Pitt stated that:

"the role of local authorities should be enhanced so that they take on responsibility for leading the coordination of flood risk management in their areas".

As the designated LLFA, WCC is responsible for leading local flood risk management across Wolverhampton.

Much of the local knowledge and technical expertise necessary for WCC to fulfil its duties as the LLFA lies with the council and its partner organisations. WCC will therefore work alongside these groups and organisations to ensure effective and consistent management of local flood risk and to contribute to the provision of a coordinated and holistic approach to flood risk management throughout the administrative area.

As the LLFA, it is the role of WCC to forge effective partnerships with Severn Trent Water (ST), the EA, and other key stakeholders and risk management authorities. These working arrangements will be formalised to ensure clear lines of communication, mutual cooperation and management through the provision of Level of Service Agreements (LoSA) or Memorandums of Understanding (MoU).

WCC has identified a number of panels, steering groups, partnerships and working groups across the different organisations and has set up a Member-led Partnership for Flood Management to provide an overarching lead. WCC has also opened up its internal steering group to act as an officer-led operational group with representatives from EA, ST and URS/Scott Wilson.

An organogram of the Wolverhampton Partnership for Flood Management is presented in Figure 2-1.
2.3 Stakeholder Engagement

As part of the PFRA, the Wolverhampton Flood Risk Partnership has engaged stakeholders representing the following organisations and authorities:

- Wolverhampton City Council.
- Severn Trent Water.
- Environment Agency.
- British Waterways.
- Highways Agency.

2.4 Public Engagement

It is recognised that members of the public may also have valuable information to contribute to the PFRA and to local flood risk management more generally across Wolverhampton. Stakeholder engagement can afford significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans. WCC will follow the guidelines outlined in the EA’s ‘Building Trust with Communities’ document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local flood forums.

2.5 Further Responsibilities

Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for LLFAs from the Flood & Water Management Act and the Flood Risk Regulations. It is important to note at this stage that not all responsibilities have been enacted yet and some are still awaiting orders to commence. However, it is anticipated that these responsibilities will include:

- **Investigating Flood Incidents** – LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have
flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out. Further information with respect to this duty is provided in Chapter 7.

- **Asset Register** – LLFAs also have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details of ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will regulate the content of the register and records.

- **SUDS Approving Body** – LLFAs are designated the SUDS Approving Body (SAB) for any new drainage system (SUDS are Sustainable Drainage Systems), and must approve, adopt and maintain any new SUDS within their area.

- **Local Strategy for Flood Risk Management** – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management. The local strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.

- **Works Powers** – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.

- **Designation Powers** – LLFAs, as well as district councils and the EA, have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood (or coastal erosion) risk management.
3 Methodology and Data Review

3.1 Introduction

The PFRA is a high-level screening exercise used to identify areas where the risk of flooding is considered to be significant and warrants further examination and management through the production of flood risk and flood hazard maps and flood risk management plans.

The approach for producing this PFRA was based upon the EA’s PFRA Final Guidance (December 2010). The PFRA is based on readily available or derivable data and with this in mind the following methodology has been used to undertake the PFRA.

3.2 Methodology

Data Collection from Partner Organisations

A WCC-led PFRA Steering Group has been established to coordinate this phase of work. Relevant authorities and organisations were identified and contacted to share data for the preparation of the PFRA (Figure 2-1).

Assessing Historic Flood Risk

Existing datasets, reports and anecdotal information from stakeholders were collated and reviewed to identify details of major past flood events and associated consequences including economic damage, environmental and cultural consequences and impacts on the local population.

Where datasets were not provided in a geo-referenced format they were geo-referenced where possible, in order to develop a GIS to identify the spatial distribution of historic flood events, and to link these to flood receptors.

Assessing Future Flood Risk

The identification of Flood Risk Areas in the PFRA also takes into account floods that could occur in the future, including predicted floods extrapolated from current conditions in addition to those with an allowance for climate change (see Section 5.4). The assessment of future flood risk will primarily rely on a technical review of the EA’s Flood Map for Surface Water (FMfSW). The FMfSW uses a numerical hydraulic model to predict the extent of flood risk from two model rainfall events (1 in 30 annual chance and 1 in 200 annual chance).

The following factors were considered when assessing future flood risk across Wolverhampton:

- Topography.
- Location and extent of ordinary watercourses.
- Location of floodplains.
- Characteristics of watercourses (e.g. lengths, modifications).
- Effectiveness of any works constructed for the purpose of flood risk management.
- Locations of populated areas.
- Areas in which economic activity is concentrated.
- Current and predicted impacts of climate change.
• Predicted impacts of any long-term developments that might affect the occurrence or significance of flooding, such as proposals for future development.

**Identifying Flood Risk Areas**

Information regarding historic and future flood risk was used to formally identify Flood Risk Areas. To achieve this, flood risk indicators were used to determine the impacts of flooding on human health, economic activity, and the environment (including cultural heritage). The use of flood risk indicators is intended to develop improved understanding of the impacts and consequences of flooding. Key flood risk indicators are summarised in Table 3-1.

**Table 3-1: Key Flood Risk Indicators**

<table>
<thead>
<tr>
<th>Impacts of Flooding on:</th>
<th>Flood Risk Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Health</td>
<td>• Number of people.</td>
</tr>
<tr>
<td></td>
<td>• Number of critical services (Hospitals, Police/Fire/Ambulance Stations, Schools, Nursing Homes, etc).</td>
</tr>
<tr>
<td>Economic Activity</td>
<td>• Number of non-residential properties.</td>
</tr>
<tr>
<td></td>
<td>• Infrastructure network (length of roads and rail).</td>
</tr>
<tr>
<td></td>
<td>• Area of agricultural land.</td>
</tr>
<tr>
<td>Environment</td>
<td>• The consequences of pollution.</td>
</tr>
<tr>
<td></td>
<td>• Impacts on designated environmental sites (Special Areas of Conservation, Special Protection Areas, Ramsar sites, Sites of Special Scientific Interest).</td>
</tr>
<tr>
<td></td>
<td>• Impacts on designated heritage assets.</td>
</tr>
</tbody>
</table>

The above indicators have been selected and analysed by Defra and the EA in order to identify areas where flood risk and potential consequences exceed a pre-determined threshold. The areas that have been identified using this methodology and exceed 30,000 people at risk have been mapped and identified as Indicative Flood Risk Areas. For further details, please refer to Defra’s Guidance for selecting and reviewing Flood Risk Areas for local sources of flooding (December 2010).

**3.3 Data Sources**

Relevant information and datasets that are held by partner organisations are catalogued in Table 3-2.
Table 3-2: Relevant information and datasets

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Description</th>
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<tbody>
<tr>
<td>Strategic Flood Risk Assessments (SFRA).</td>
<td>SFRAs contain useful information on historic flooding, including local sources of flooding from surface water, groundwater, ordinary watercourses and canals.</td>
</tr>
<tr>
<td>Historical flooding records.</td>
<td>Historical records of flooding from surface water, groundwater, ordinary watercourses and canals.</td>
</tr>
<tr>
<td>Anecdotal information relating to local flood history and flood risk areas.</td>
<td>Anecdotal information from authority members regarding areas known to be susceptible to flooding from excessive surface water or groundwater or from ordinary watercourses or canals.</td>
</tr>
<tr>
<td>Anecdotal information from Parish Councils within Wolverhampton.</td>
<td>Anecdotal information on flood risk, flood history and local flood hotspots.</td>
</tr>
<tr>
<td>Highways Flooding Reports.</td>
<td>Highways Flooding Reports for a number of locations within Wolverhampton, including analysis of the flood risk at each location.</td>
</tr>
<tr>
<td>Areas Susceptible to Surface Water Flooding</td>
<td>The first generation national mapping, which outlines areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more susceptible)</td>
</tr>
<tr>
<td>Flood Map for Surface Water.</td>
<td>The updated (second generation) national surface water flood mapping which was released at the end of 2010. This dataset includes two flood probabilities (1 in 30 and 1 in 200 annual chance of occurring) and two depth bandings (greater than 0.1m and greater than 0.3m)</td>
</tr>
<tr>
<td>Flood Map (Rivers and the Sea).</td>
<td>Shows the extent of flooding from rivers with a catchment of more than 3km² and flooding from the sea.</td>
</tr>
<tr>
<td>Areas Susceptible to Groundwater Flooding.</td>
<td>Coarse scale national mapping showing areas which are susceptible to groundwater flooding.</td>
</tr>
<tr>
<td>National Receptors Dataset.</td>
<td>A national dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations.</td>
</tr>
<tr>
<td>Indicative Flood Risk Areas.</td>
<td>Nationally identified flood risk areas, based on the definition of ‘significant’ flood risk described by Defra and the Welsh Assembly Government (WAG)</td>
</tr>
<tr>
<td>Historic Flood Map.</td>
<td>Attributed spatial flood extent data for flooding from all sources.</td>
</tr>
<tr>
<td>North Wolverhampton and South Wolverhampton Catchment Flood Management Plans (CFMPs).</td>
<td>CFMPs consider all types of inland flooding from rivers, groundwater, surface water and tidal flooding and are used to plan and agree the most effective way to manage flood risk in the future.</td>
</tr>
<tr>
<td>DG5 Register for Severn Trent areas.</td>
<td>DG5 Register logs and records of sewer flooding incidents in each area.</td>
</tr>
</tbody>
</table>
Table 3-2: Relevant information and datasets (continued)

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Waterways canal network.</td>
<td>Detailed GIS information on the British Waterways canal network, including the location of canal centrelines, sluices, locks, culverts, etc.</td>
</tr>
<tr>
<td>Records of canal breaches and overtopping events.</td>
<td>Records of historical canal breaches and canal overtopping events across Wolverhampton.</td>
</tr>
<tr>
<td>Other</td>
<td>Relevant datasets. From the British Geological Society, Housing Communities Agency, Natural England, Network Rail and developers.</td>
</tr>
</tbody>
</table>

3.4 Data Limitations

A brief assessment of the data collection process is included in this chapter to provide transparency with respect to the methodology. It is intended that highlighting the data limitations described below will serve as a catalyst for improving the collection of flood risk data in the future.

Inconsistent Recording Systems

The lack of a consistent flood data recording system across WCC and the other stakeholders has led to inconsistencies in the recording of flood event data. This has resulted in incomplete flood records or flooding not being recorded at all. Further information on addressing this issue in the future is included in Chapter 7.

Incomplete Datasets

As a result of the lack of consistent flood data recording arrangements, some flood datasets are not exhaustive and are unlikely to accurately represent the complete flood risk issues in a particular area. The corresponding gaps in flood data will hinder the identification of accurate flood risk areas.

ST maintain a register of properties which have suffered flooding from public sewers in order to fulfil statutory commitments set by OFWAT (the DG5 Register). The register includes incidents of both internal property flooding together with flooding to curtilages, highway and other open areas (external flooding), but only flooding due to hydraulic deficiencies are recorded on the DG5 register. Sewer flooding due to blockages is not recorded on the DG5 register. Properties flooded in severe weather (rare events) are recorded but OFWAT do not require these to go onto the DG5 register. It is also important to note that the DG5 register is not a full record of properties that have experienced sewer flooding in the past, since on completion of a flood alleviation scheme, properties are removed from the register.

Variable Quality of Data

In line with the above, there was found to be varied quality in historic flood records and information. For example, some datasets were provided with details of historic flood events with precise geo-referenced locations, whereas others were provided as brief anecdotal paper records of approximate flooded areas.

Records of Causes and Consequences of Flooding

Very few data providers were able to provide comprehensive details of the causes and consequences of specific past flood events, making accurate interpretation of historic flooding difficult.
3.5 Quality Assurance, Security and Data Restrictions

The data collected were subject to quality assurance measures to monitor the quality and accuracy of acquired information and datasets. A qualitative score was applied to each dataset, using the Data Quality System provided in the SWMP Technical Guidance document (March 2010). The system is summarised in Table 3-3.

Table 3-3: Summary of the Data Quality System (Defra SWMP Technical Guidance, March 2010)

<table>
<thead>
<tr>
<th>Data Quality Score</th>
<th>Description</th>
<th>Explanations</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Best Available</td>
<td>No better available; not possible to improve in the near future.</td>
<td>High resolution LiDAR, river flow data, rain-gauge data.</td>
</tr>
<tr>
<td>2</td>
<td>Data with Known Deficiencies</td>
<td>Best replaced as soon as new data is available.</td>
<td>Typical sewer or river model that is a few years old.</td>
</tr>
<tr>
<td>3</td>
<td>Gross Assumptions</td>
<td>Not invented but based on experience and judgement (of unknown reliability).</td>
<td>Location, extent and depth of surface water flooding.</td>
</tr>
<tr>
<td>4</td>
<td>Heroic Assumptions</td>
<td>An educated guess.</td>
<td>Ground roughness for 2d models.</td>
</tr>
</tbody>
</table>

The use of some of the datasets made available for this PFRA has been restricted. These include records of property flooding held by ST. Necessary precautions must be taken to ensure that all information given to third parties is treated as confidential and is in accordance with data and licensing agreements. In some instances, before data can be passed to third parties, permission must be sought from the relevant data provider. The information must not be used for anything other than the purpose stated in the agreement. No information may be copied, reproduced or reduced to writing, other than what is necessary for the purpose stated in the agreement.

The security of data is also a key consideration when it comes to collecting and storing sensitive data. All data collected must be stored on local servers which are password protected. WCC will adhere to these data security measures to ensure that sensitive data is held in a secure manner.

A summary table illustrating the restrictions on the use of this data is included in Table 3-4.

Table 3-4: Summary of data restrictions and licensing details

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Restrictions on Use of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SEVERN</strong></td>
<td>The use of provided data is restricted to WCC and its consultants for the preparation of the preliminary flood risk assessment.</td>
</tr>
<tr>
<td><strong>TRENT</strong></td>
<td>The use of provided data is restricted to WCC and its consultants for the preparation of the preliminary flood risk assessment.</td>
</tr>
<tr>
<td><strong>WATER</strong></td>
<td>The use of some data is restricted to WCC and its consultants for the preparation of the preliminary flood risk assessment. The use of other data is unrestricted.</td>
</tr>
<tr>
<td><strong>Environment Agency</strong></td>
<td>The use of provided data is restricted to WCC and its consultants for the preparation of the preliminary flood risk assessment.</td>
</tr>
<tr>
<td><strong>British Waterways</strong></td>
<td>The use of provided data is restricted to WCC and its consultants for the preparation of the preliminary flood risk assessment.</td>
</tr>
</tbody>
</table>
4 Past Flood Risk

4.1 Overview of Historic Flooding in Wolverhampton

Records of historic flood events and flooding hotspots were compiled from across WCC’s administrative area. A summary map highlighting the locations of these flood hotspots is presented in Figure 4-1 (Annex 5).

The flood events were derived from a range of flood sources, although in many cases the source of flooding was unknown or not recorded. A summary of the main flood events is included below.

In general terms, Wolverhampton has not historically suffered from major flooding. For example, Wolverhampton was not substantially affected by flooding during summer 2007, for reasons linked with its historical drainage infrastructure development, its natural contours and its location upstream of the country’s primary river basins.

4.2 Surface Water Flooding

Surface water (pluvial) flooding occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground. The flashy nature and short duration of such events can make them difficult to mitigate. Table 4-1 summarises where surface water flooding has previously been recorded within Wolverhampton.

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Source</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penn</td>
<td>1998</td>
<td>Surface water</td>
<td>Localised flooding</td>
</tr>
<tr>
<td>Penn Road</td>
<td>Unknown</td>
<td>Surface water and sewer flooding</td>
<td>Localised flooding</td>
</tr>
<tr>
<td>Black Brook Way</td>
<td>Unknown</td>
<td>Surface water flooding</td>
<td>Unknown</td>
</tr>
<tr>
<td>Tettenhall</td>
<td>Unknown</td>
<td>Surface water flooding</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

4.3 Canal and Ordinary Watercourse Flooding

Information was obtained from British Waterways about the canal network throughout Wolverhampton, including the location of canals, weirs, sluices and locks. British Waterways also provided details of historic breaches or overtopping events. The information is summarised in Table 4-2.

There are records of flooding from canals in Wolverhampton, but it is not clear if the flooding has been due to canal overtopping alone, or if there have been interactions with ordinary watercourses.

Historically, Wolverhampton has not suffered substantial flooding from ordinary watercourses. The vast majority of flooding incidences have resulted from blockages to watercourses rather than insufficient channel capacity.

Culvert blockage is mitigated by WCC inspecting and clearing trash screens, typically every 1 – 2 weeks.

---

Table 4-2: Canal and ordinary watercourse flooding

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Source</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinfold Grove</td>
<td>Unknown</td>
<td>Merry Hill Brook</td>
<td>Minor flooding</td>
</tr>
<tr>
<td>Wightwick Mill Farm</td>
<td>Unknown</td>
<td>Smestow Brook/Canal interaction</td>
<td>Canal bank failure led to flooding from Brook</td>
</tr>
<tr>
<td>Pendeford Brook</td>
<td>1998</td>
<td>Pendeford Brook</td>
<td>40-50 homes flooded, people evacuated</td>
</tr>
<tr>
<td>Eccleshall Avenue</td>
<td>Unknown</td>
<td>Oxley Brook</td>
<td>River overtops following heavy rain – localised flooding</td>
</tr>
<tr>
<td>Graiseley Brook</td>
<td>1998</td>
<td>Graiseley Brook</td>
<td>Localised flooding of low lying land</td>
</tr>
<tr>
<td>Pendeford</td>
<td>July 2007</td>
<td>Worcestershire Canal overtopping</td>
<td>Localised internal and external flooding</td>
</tr>
</tbody>
</table>

The flood event at Pendeford Brook in 1998 is the largest on record in Wolverhampton. Flooding occurred from a length of open watercourse in South Staffordshire in land that is under the jurisdiction of WCC. The cause of flooding was attributed to a combination of the Pendeford Brook channel being narrowed by unmanaged vegetation growth, high water in the River Penk locking discharge from Pendeford Brook, and surface runoff. The latter two causes were the result of rainfall over several preceding days. Flooding occurred on two consecutive weekends, to a magnitude of approximately 1 in 40 year events. In response to the identified causes and consequences, WCC instigated a flood management strategy of managing vegetation growth to create an open floodplain, and to date there has not been a repeat flood event at the site. Because the flood risk appears to have been mitigated, there are not considered to be significant consequences for future flood events.

4.4 Groundwater Flooding

Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers, although there is increasing awareness that it can also be associated with more localised floodplain sands and gravels.

Groundwater flooding has occurred in localised areas across eastern Wolverhampton where it has mostly affected gardens and allotments. At present, precise information on the extent of groundwater flooding is not available, but the general areas of reported groundwater flooding are:

- Newbolds.
- Scotlands.
- Wood Hayes.
- Merry Hill.
- Bradmore.
- Blakenhall.
Several historic industrial groundwater abstractions have been identified. There is no evidence of groundwater flooding since the early 1990s, so it is not considered that there are any problems associated with the rebound of groundwater levels following reductions in industrial abstractions (or any other source of groundwater flooding).

4.5 Sewer Flooding

Sewer flooding is usually caused by excess surface water entering the drainage network but can also be due to ‘one off’ events such as trees falling and fly tipping blocking drains and screens.

DG5 registers from ST were analysed to investigate the occurrence of sewer flooding incidents across Wolverhampton. Sewer flooding has been recorded at a total of 278 individual locations in the study area, from surface and foul sewers, and including internal and external flooding. The causes of flooding (e.g. heavy rainfall, sewer blockage or capacity), and full descriptions of the consequences of flooding have generally not been recorded. A broad summary of areas within Wolverhampton where there are multiple records of sewer flooding (i.e. not listing every individual location) is as follows:

- Claregate – 10.
- Coven – 32.
- Fordhouses – 12.
- Oxley – 10.
- Stowheath – 11.
- Tettenhall – 29.
- Wednesfield – 30.
- Wolverhampton City – 91.

4.6 Consequences of Historic Flooding

Due to the scale of historic flooding in Wolverhampton, the lack of repeat events, and as a result of data limitations, insufficient data is available to draw definitive conclusions on the impacts and consequences of the majority of historic flood events on people, the economy and the environment. Many of the relatively severe historic flood events in Wolverhampton have previously been investigated and mitigated. As a result no historic flood events can be definitively assessed as having had ‘significant harmful consequences’. The available details of historic floods have been recorded in Annex 1 of the Preliminary Assessment Spreadsheet, which will also be used as a template for recording information on future flood events.

WCC understands that every flood incident impacts on local people and each future flood record will be reviewed as part of their longer term Local Flood Risk Management Strategy.
5 Future Flood Risk

5.1 Overview of Future Flood Risk

Surface Water Flooding

No detailed local information is currently available on surface water flood risk in Wolverhampton. However, a Surface Water Management Plan (SWMP) for the entire Wolverhampton area is currently under development by URS/Scott Wilson, and is due to be published in Autumn 2011. The results from the SWMP will be used to inform the second cycle of the PFRA process and the production of flood hazard and flood risk maps.

The EA has two national datasets showing the risk of surface water flooding at the national level. The first generation national mapping; Areas Susceptible to Surface Water Flooding (AStSWF), contains three susceptibility bandings (Less, Intermediate and More susceptible) for a model rainfall event with a 1 in 200 chance of occurring in any given year. The second and most recent generation national surface water assessment is the Flood Map for Surface Water (FMfSW), which is an updated model containing two flood probabilities (1 in 30 annual chance and 1 in 200 annual chance) and two depth bandings for each flood probability (‘shallow flooding’, i.e. greater than 0.1m, and ‘deep flooding’, i.e. greater than 0.3m). The risk of sewer flooding is inherently considered by using the Environment Agency’s Flood Maps for Surface Water which take account of the drainage system by applying a national ‘sewer infiltration rate’ of 12mm/hour. The FMfSW for Wolverhampton is presented in Figure 5-1 (Annex 5).

The number of properties at risk of surface water flooding within Wolverhampton has been estimated from the FMfSW database. For a rainfall event with a 1 in 200 annual chance of occurring, 29,400 properties are at risk of flooding to a depth of 0.1m, and 8,700 properties are at risk of flooding to a depth of 0.3m. Of the properties at risk, over three quarters are residential.

Table 5-1 includes a comparison of the estimated number of properties (residential and non-residential) at risk of surface water flooding across Wolverhampton with other nearby West Midlands Councils.

It must be emphasised at this point that PFRAs are coarse scale assessments and as such are not suitable for individual property analysis.

Table 5-1: Properties at risk from surface water flooding

<table>
<thead>
<tr>
<th>Authority</th>
<th>Estimated Properties at Risk of Surface Water Flooding</th>
<th>Shallow Flooding*</th>
<th>Deep Flooding**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birmingham</td>
<td>89,800</td>
<td>29,300</td>
<td></td>
</tr>
<tr>
<td>Wolverhampton</td>
<td>29,400</td>
<td>8,700</td>
<td></td>
</tr>
<tr>
<td>Dudley</td>
<td>27,500</td>
<td>10,400</td>
<td></td>
</tr>
<tr>
<td>Sandwell</td>
<td>28,100</td>
<td>9,000</td>
<td></td>
</tr>
<tr>
<td>Walsall</td>
<td>26,100</td>
<td>8,100</td>
<td></td>
</tr>
<tr>
<td>Solihull</td>
<td>18,300</td>
<td>5,000</td>
<td></td>
</tr>
</tbody>
</table>

* shallow flooding - to a depth of 0.1m from an event with a 1 in 200 annual chance of occurring
** deep flooding - to a depth of 0.3m from an event with a 1 in 200 annual chance of occurring
Groundwater Flooding

There is no local information available that provides evidence on future groundwater flood risk across Wolverhampton. Groundwater rebound from the cessation of historic abstractions is not considered to be an issue. The EA's national dataset, Areas Susceptible to Groundwater Flooding, has been used as the basis of the assessment of future flood risk from groundwater. A map of the areas susceptible to groundwater flooding in Wolverhampton is presented in Figure 5-2 (Annex 5). It should be noted that Figure 5-2 shows the percentage area of grid squares that are considered to be susceptible to groundwater flooding, not the percentage risk. Areas at high susceptibility of groundwater flooding are generally in the east of the district.

Canals and Ordinary Watercourses

There is currently no information available on future flood risk from canals. However, British Waterways are developing a study to improve understanding of future flood risks from canals, which will be used to inform the second cycle of the PFRA process.

The EA fluvial flood map has been used to assess the risk of flooding from ordinary watercourses. The Detailed River Network was used to identify ordinary watercourses and this was cross referenced with the EA Flood Map. Based on this methodology, no areas were identified as being at significant risk of flooding from ordinary watercourses.

5.2 Locally Agreed Surface Water Information

An appropriate definition of ‘locally agreed surface water information’ has been agreed between WCC and the EA as to what surface water information best represents local conditions across Wolverhampton.

The FMfSW dataset has been adopted for the assessment of ‘locally agreed surface water information’, as it best represents surface water flooding across Wolverhampton and is considered to be the most appropriate source of information. At present there is no supplemental information on local drainage capacity or future flooding.

The SWMP for Wolverhampton (due to be published in Autumn 2011) will provide more accurate information on future flood risk in the district and will be used to inform the later stages of work (e.g. Flood Risk and Flood Hazard Maps) required under ‘The Regulations’.

5.3 Potential Consequences of Future Flooding

In order to assess the potential consequences of future flooding, the EA has used the FMfSW and the National Receptors Database to identify areas that exceed the thresholds described in Table 5-2.

Table 5-2: Flood risk thresholds used to identify future consequences of flooding

<table>
<thead>
<tr>
<th>‘Significant harmful consequences’ defined as greater than…</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 people</td>
<td>Flooded to a depth of 0.3m during a rainfall event with a 1 in 200 annual chance of occurring (or 0.5%)</td>
</tr>
<tr>
<td>20 businesses</td>
<td></td>
</tr>
<tr>
<td>1 critical service</td>
<td></td>
</tr>
</tbody>
</table>
The assessment was carried out based on 1km² national grid squares and the areas within Wolverhampton where flood risk is considered to exceed the thresholds described in Table 5-2 are presented in Figure 5-3 (Annex 5).

5.4 Climate Change and Long Term Developments

The Evidence of Climate Change

There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation, however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can’t be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

Key Projections for Humber River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are

- Winter precipitation increases of around 12% (very likely to be between 2 and 26%).
- Precipitation on the wettest day in winter up by around 12% (very unlikely to be more than 24%).
- Relative sea level at Grimsby very likely to be up between 10 and 41cm from 1990 levels (not including extra potential rises from polar ice sheet loss).
- Peak river flows in a typical catchment likely to increase between 8 and 14%.

Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of
interactions with drains, sewers and smaller watercourses. Even small rises in sea level could add to very high tides so as to affect places a long way inland.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

Key Projections for Severn River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 12% (very likely to be between 2 and 26%).
- Precipitation on the wettest day in winter up by around 9% (very unlikely to be more than 22%).
- Relative sea level at Bristol very likely to be up between 10 and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss).
- Peak river flows in a typical catchment likely to increase between 9 and 18%.

Increases in rain are projected to be greater at the coast and in the south of the district.

Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability.

Wetter winters and more of this rain falling in wet spells may increase river flooding along the Severn and its tributaries. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

Adapting to Change

Past emission means some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

Although the broad climate change picture is clear, we have to make local decisions against deeper uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.
Long term Developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

In England, Planning Policy Statement 25 (PPS25): Development and Flood Risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

In Wales, Technical Advice Note 15 (TAN15): Development and Flood Risk sets out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is "to direct new development away from those areas which are at high risk of flooding".

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

5.5 Proposed Major Developments

The Black Country Core Strategy lists the following as major development areas:

- Wolverhampton City Strategic Centre – 3,230 additional residential dwellings and 220,000 square metres of office development to 2026,
- Regeneration Corridor 1 – Pendeford to Fordhouses – 71ha of employment land to 2026,
- Regeneration Corridor 2 – Stafford Road – 1,643 residential dwellings and 94ha of employment land to 2026,
- Regeneration Corridor 3 – South of Wolverhampton City Strategic Centre – 563 residential dwellings and 26ha of employment land to 2026,
- Regeneration Corridor 4 – Wolverhampton to Bilston – 4,310 residential dwellings and 221ha of employment land to 2026,
- Regeneration Corridor 5 – Loxdale (Wolverhampton) and Moxley (Walsall) – 860 residential dwellings and 86 ha employment land to 2026,
- Regeneration Corridor 6 – Darlaston (Staffordshire), Willenhall (Walsall) and Wednesfield (Wolverhampton) – 2,048 residential homes and 338 ha employment land to 2026.

Area Action Plans (AAPs) have been published for Wolverhampton City Strategic Centre, Bilston Corridor and Stafford Road, and these areas in relation to flood risk are shown in Figure 5-1 (Annex 5). No significant past or future flooding has been identified in any of these areas.
6 Review and Identification of Flood Risk Areas

6.1 Overview

In order to ensure a consistent national approach, Defra and WAG have identified significance criteria and thresholds to be used for defining Flood Risk Areas. Guidance on applying these thresholds is published in Defra’s document “Selecting and Reviewing Flood Risk Areas for Local Sources of Flooding”. Defra have set out agreed key risk indicators and threshold values which must be used to determine Flood Risk Areas, and these have been applied at the national level by the EA.

The methodology is based on using national flood risk information to identify 1km squares where local flood risk exceeds a defined threshold, as described below:

- The FMfSW (>0.3m depth of flooding) was used to count the number of people, non-residential properties and critical services at risk of surface water flooding within each 1km$^2$ cell.

- Where a 1km$^2$ cell is identified as having more than 200 people and/or more than 20 non-residential properties and/or one or more critical service at risk of surface water flooding, the cell is classified as ‘a place above flood risk thresholds’.

- Clustering analysis was used to identify clusters of 1km$^2$ cells which are ‘places above flood risk thresholds’.

- A cluster containing 30,000 people or more at risk of surface water flooding has been classified as an ‘Indicative Flood Risk Area’.

The EA have identified ten Indicative Flood Risk Areas across the country, one of which lies within the West Midlands and covers Wolverhampton (Figure 6-1, Annex 5). It should be noted that the West Midlands Indicative Flood Risk Area also covers parts of the other councils’ areas, for which there are separate LLFAs. There is active dialogue and exchange of ideas between the councils, for example during regular LLFA networking groups held with the EA.

6.2 Review of the Indicative Flood Risk Area

Figure 6-1 shows the geographical extent of the proposed Indicative Flood Risk Area for the West Midlands, including Wolverhampton. This is the EA national level assessment based on the FMfSW, which has been adopted in this report for the assessment of ‘locally agreed surface water’. Of the total WCC administrative area of 55.98km$^2$, 4.04% lies outside of the Indicative Flood Risk Area (and not within any other LLFA area), but because no significant flooding has been identified in these administrative areas during the course of the preliminary assessment, it is not proposed to make any alteration to the Indicative Flood Risk Area.

6.3 Identification of Flood Risk Areas in Wolverhampton

At this stage, on the basis of reviewing information about past flooding and information about future flooding, no amendments to the Indicative Flood Risk Area within the administrative area of Wolverhampton have been made and no additional Flood Risk Areas in Wolverhampton have been identified. As such, no further information is included in Annex 3 (Records of Flood Risk Areas and their Rationale).

Flooding has not traditionally been a concern in Wolverhampton. Only a small number of flood events have been recorded historically and these appear to have been managed and mitigated effectively.
National level assessment has identified that flooding from surface runoff may become a significant risk in the future, and a SWMP for Wolverhampton is currently in progress to analyse flooding from pluvial and other sources in detail at the local scale. The SWMP will be used to inform subsequent stages of the PFRA process.
7 Next Steps

7.1 Future Data Management Arrangements

In order to continue to fulfil their role as LLFA, WCC is required to lead the investigation of future flood events and ensure continued collection, management, assessment and storage of flood risk data and information.

It is likely that this requirement will be met most effectively by the District and Borough councils recording events in their respective administrative areas. However, it is crucial that all records of flood events are documented consistently and in accordance with the INSPIRE Directive (2007/2/EC), and it is recommended that a centralised database should be kept up to date by WCC. The database would comprise an evidence base to inform future assessments and reviews and to provide input into the mapping and planning stages. The proposed method for flood event data collection and management is included below. A simple spreadsheet system has been created in which WCC can record details of flooding in its administrative area. The fields are colour coded to represent which details are compulsory, and those that would be useful to have but are not essential. Figure 7-1 and Figure 7-2 show the spreadsheet system that will be adopted.
7.2 Scrutiny and Review Procedures

The scrutiny and review procedures that must be adopted when producing a PFRA are set out by the EC. Meeting quality standards is important in order to ensure that the appropriate sources of information have been used to understand flood risk and the most significant flood risk areas are identified.

Another important aspect of the review procedure is to ensure that the guidance is applied consistently; a consistent approach will allow all partners to understand the risk and manage it appropriately. The scrutiny and review procedure will comprise two key steps.

Local Authority Review

This PFRA was reviewed by the Wolverhampton Council’s Cabinet prior to submission to the EA.

Environment Agency Review

Under the Flood Risk Regulations, the EA has been given a role in reviewing, collating and publishing all of the PFRAs once submitted.

The EA will undertake a technical review (area review and national review) of the PFRA, which will focus on instances where Flood Risk Areas have been amended and ensure the format of these areas meets the defined standard. If satisfied, they will recommend submission to the relevant Regional Flood Defence Committee (RFDC) for endorsement. RFDCs will make effective use of their local expertise and ensure consistency at a regional scale. Once the RFDC has endorsed the PFRA, the relevant EA Regional Director will sign it off, before all PFRAs are collated, published and submitted to the EC.

7.3 Future Requirements

Under the Floods and Water Management Act, LLFAs are required to develop a Local Flood Risk Management Strategy. This requires the LLFA to develop, maintain apply and monitor a strategy for local
flood risk management across its area. The information gathered and presented in this PFRA can be used to support the development of the Local Flood Risk Management Strategy for WCC.

A Surface Water Management Plan (SWMP) for Wolverhampton is due to be published in Autumn 2011. The SWMP is a detailed local study, and results from the SWMP will be used to inform the production of flood hazard and flood risk maps, development of the Local Flood Risk Management Strategy, and the second cycle of the PFRA process.

The Flood Risk Regulations require that after completing the PFRA, LLFAs with Indicative Flood Risk Areas are to prepare Flood Hazards and Flood Risk Maps by the 22nd June 2013, and a Flood Risk Management Plan by the 22nd June 2015.

The first review cycle of the PFRA will be led by WCC and must be submitted to the EA by the 22nd of June 2017. They will then submit it to the European Commission by the 22nd of December 2017 using the same review procedure described above.

### 7.4 Additional Information

Further information can be found on the Environment Agency PFRA e-Learning module [http://learning.environment-agency.gov.uk/courses/FCRM/capacity](http://learning.environment-agency.gov.uk/courses/FCRM/capacity) which has been developed as part of Defra’s Capacity Building Strategy and is designed to provide users with an increased knowledge of the background and methodology involved in carrying out a PFRA.

This guidance should be used by LLFAs when undertaking future Flood Risk Assessment tasks. The production of this PFRA will provide details of flood risk at this current time. The flood risk will inevitably change in the future, and therefore the PFRA process will need to be repeated (every 6 years). Guidance provided on the Defra Capacity Building website will ensue LLFAs are up to date with report requirements, and changes in the Flood Risk Regulations.
8 References


IPCC, Fourth Assessment Report (AR4) http://www.ipcc.ch/


Annex 1: Records of Past Floods and their Significant Consequences
Wolverhampton City Council
Preliminary Flood Risk Assessment

<table>
<thead>
<tr>
<th>Name of locality</th>
<th>Location Descriptive Information</th>
<th>Flood ID</th>
<th>Date the flood commenced</th>
<th>Duration of flood</th>
<th>Probability of flood occurring in any given year</th>
<th>Cause of flooding</th>
<th>Significant consequences to property and the environment</th>
<th>Other human health effects</th>
<th>Other social effects</th>
<th>Other economic effects</th>
<th>Other cultural heritage effects</th>
<th>Other environment effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pendeford Brook</td>
<td>The flood event at Pendeford Brook in 1998 is the largest on record in Wolverhampton. Flooding occurred as a result of open stream incursion at Swallow Lock and is under the jurisdiction of WCC. The cause of flooding was attributed to a combination of the connected stream being released by upstream vegetation growth and rainfall exceeding the drainage capacity of the area.</td>
<td>1998-04-15</td>
<td>0.25</td>
<td>20-50</td>
<td>Surface runoff</td>
<td>High</td>
<td>Natural exceedance</td>
<td>Natural flood</td>
<td>Natural exceedance</td>
<td>Natural flood</td>
<td>Natural exceedance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The surface runoff exceeded the drainage capacity in several places, and so probably had a 1 in 30 to 1 in 50 chance of occurring in any given year.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Properties evacuated. No casualties.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Annex 2: Records of Future Floods and their Consequences
Where residential or non-residential properties have been counted, it is important to record the method of counting, to ensure consistency and reliability. Two methods are used:

- 'Detailed GIS' (using property outlines, as per Environment Agency guidance)
- 'Simple GIS' (using property points)

Record the number of residential properties where the building structure would be affected either internally or externally if the flood were to occur.

Record the number of non-residential properties where the building structure would be affected either internally or externally if the flood were to occur.

**Type of software used to create future flood information.**

- **First Model:**
  - Consequence: The modelled flooding is defined as the extent of inundation predicted by the model. This can be affected by various factors such as the accuracy of input data and the assumptions made during the model setup. The model may not be able to accurately represent the location and extent of flooding due to uncertainties in input data and the model itself.
  - Probability: The probability of flooding is determined by the model and can be influenced by the input data and assumptions used.
  - Source: The source of the modelled flood information can vary depending on the model used and the data input.

- **Second Model:**
  - Consequence: The modelled flooding is defined as the extent of inundation predicted by the model. This can be affected by various factors such as the accuracy of input data and the assumptions made during the model setup. The model may not be able to accurately represent the location and extent of flooding due to uncertainties in input data and the model itself.
  - Probability: The probability of flooding is determined by the model and can be influenced by the input data and assumptions used.
  - Source: The source of the modelled flood information can vary depending on the model used and the data input.

**Probability refers to the 200 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model.**

- **Flow routes:** The flow routes are dictated by topography, with a uniform allowance of 12mm/hr for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas.

- **Defences:** Flood defences are not explicitly identified; the mapping identifies where groundwater is likely to rise and where obstructions to be approximated. No allowance made for drainage, pumping, or other works constructed for the purpose of flood risk management.

- **Topography:** Topography is derived from LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m), with areas that may flood defined for catchments >3km² by routing appropriate flows for flooding of greater than 600mm.

- **Modelled outline:** The modelled outline is not a perfect match, hence the following levels of confidence:
  - 'High' (very positive evidence of source - about 90% confident that outline is correct)
  - 'Reasonable' (reasonably positive evidence of source but not compelling - about 70% confident that outline is correct)
  - 'Low' (poor match, sparse data - about 20% confident that outline is correct)
  - 'Unknown' (source assumed - about 20% confident that source is correct)

- **Rivers:** The river modeling covers the main river system, with a uniform allowance of 12mm/hr for manmade drainage in urban areas. No allowance made for local variations in drainage, pumping, or other works constructed for the purpose of flood risk management.

- **Tidal:** The tidal modeling considers the 200 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model.

- **Tidal defences:** The tidal defences include floodplains not explicitly identified; the mapping identifies where groundwater is likely to rise and where obstructions to be approximated. No allowance made for drainage, pumping, or other works constructed for the purpose of flood risk management.

- **Modelling uncertainties:** Modelling uncertainties can arise from various factors, including data quality, model assumptions, and input variables. These uncertainties can affect the reliability of the predictions made by the models.

- **Local variations:** Local variations in drainage, pumping, and other works constructed for the purpose of flood risk management can influence the predictions made by the models.

- **Environment Agency flood maps:** The Environment Agency provides flood maps that can be used to assess flood risk. These maps include flood risk areas and flood levels for different return periods.

- **JBA's JFLOW–GPU model:** This model is used to create flood risk maps for different return periods. The model can be used to assess the probability of flooding and to identify areas at risk of flooding.

- **Environment Agency low 2010-11 ArcGIS maps:** These maps show flood risk areas and flood levels for different return periods. The maps can be used to assess flood risk and to identify areas at risk of flooding.

- **Wolverhampton SO9150098500 Various locations:** This location is identified as an area at risk of flooding. The National Grid Reference provided is for the approximate centre of Wolverhampton.

- **Notes:** A sequential number, postal address names, and descriptions including the number of critical services flooded are provided in the notes section.

- **Optional comments:** Any additional comments about the future flood record are provided in the optional comments section.
Annex 3: Records of Flood Risk Areas and their Rationale
Preliminary Flood Risk Assessment

Rationale detail

Pick the source from which there is a significant flood risk. Refer to the PFRA Property count method

Other human health

Property count method Other economic

Where residential or non-residential properties have been counted, it is important to record the method of counting, to be consistent. The options are:

- 'Detailed GIS' (using property outlines, as per Environment Agency guidance)
- 'Simple GIS' (using property points)

Significant consequences to

Has the Flood Risk Area been identified as a result of significant economic consequences?

Origin of Flood Risk Area

Additional source(s) of flooding

If there is also significant flood risk generated by another source (other than the Main source of flooding), report the source(s) here, using the same source terms.

Main character of

Significant consequences to the environment?

Significant consequences to cultural heritage?

Main source of flooding

National Grid Reference of the centroid (centre point, falls within polygon) of the Flood Risk Area.

Main characteristic of

Natural exceedance (of capacity), 'Defence exceedance' (floodwater overtopping defences or infrastructure), 'Failure' (of natural or artificial defences or infrastructure, or of a pump or system), or 'No data'. Most UK floods are 'Natural floods'.

Record the number of residential properties where the building structure would be affected either internally or externally by the flood.

Main source of flooding

Pick from drop-down

Pick from drop-down

Pick from drop-down

Pick from drop-down

Number between 1-9999

Auto-populated

Flood Risk Area. Refer to Defra & WAG guidance to LLFAs on "Selecting and reviewing Flood Risk Areas" for definitions of sources.

Example: 1 London SX1234512345 Surface runoff NA High Natural exceedance Natural flood Yes 50000 Detailed GIS No No No Indicative NA NA indicative Flood Risk Area UKE10000012A0001

Final June 2011
## Annex 4: Review Checklist

<table>
<thead>
<tr>
<th>Checklist questions</th>
<th>Notes for completion</th>
<th>UPE</th>
<th>Environment Agency area review</th>
<th>Environment Agency addional review</th>
</tr>
</thead>
</table>

### 1.1 Collect and analyse information

1.1.1.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.2.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.3.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.4.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.5.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.6.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.7.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.8.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.9.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

1.1.10.1 Is the LLFA within an indicative Flood Risk Area? Yes/No

### 2.1 Determine appropriate data sources

2.1.1.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.2.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.3.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.4.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.5.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.6.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.7.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.8.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.9.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

2.1.10.1 Has information been requested from all relevant fields in the spreadsheet? Yes/No

### 3.1 Enter information on past and future flooding and flood consequences

3.1.1.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.2.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.3.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.4.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.5.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.6.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.7.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.8.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.9.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

3.1.10.1 Have records of past flooding with significant consequence been included in the spreadsheet? Yes/No

### 4.1 Complete Preliminary Assessment Report

4.1.1.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.2.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.3.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.4.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.5.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.6.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.7.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.8.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.9.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

4.1.10.1 Does the Preliminary Assessment Report cover all the areas of the LLFA? Yes/No

### 5.1 Ensure indicative Flood Risk Area

5.1.1.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.2.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.3.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.4.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.5.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.6.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.7.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.8.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.9.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

5.1.10.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

### 6.1 Determine appropriate data systems

6.1.1.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.2.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.3.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.4.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.5.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.6.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.7.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.8.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.9.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No

6.1.10.1 Has the locally agreed surface water information been included in the spreadsheet? Yes/No
Annex 5: GIS Layer of Flood Risk Areas