This report describes work commissioned by Martin Jackson, on behalf of Amey Herefordshire.

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Acknowledgments

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References

Defra and WAG guidance on Flood Risk Areas 2010; Environment Agency (2010 and later amendments) Preliminary Flood Risk Assessment (PFRA) Final guidance and annexes and guidance notes associated with Environment Agency data as dated. Standard text on climate change and development in Sections 5.4 and 5.5 © Environment Agency

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Executive Summary

This Preliminary Assessment Report for Herefordshire has been prepared as part of the duties established under the Flood Risk Regulations 2009. It is due for submission to the Environment Agency (EA) by 22nd June 2011. The Regulations transpose and implement the requirements of the European Floods Directive, which aims to provide a consistent approach to managing flood risk across Europe. The first stage of the process is to undertake a Preliminary Flood Risk Assessment (PFRA). This involves the review of past floods and the potential for future floods, as well as determining and reviewing the presence of any “areas of significant flood risk”, the so called Flood Risk Areas. Where such Flood Risk Areas have been determined, on the basis of national guidance issued by Defra and Welsh Assembly Government (WAG), Lead Local Flood Authorities (LLFAs) are required to review and if necessary propose amendments to the indicative areas using locally held information. No Flood Risk Areas have been proposed in Herefordshire.

Herefordshire Council, as a LLFA, has a responsibility under both the Flood Risk Regulations 2009 and the Flood & Water Management Act 2010 for managing local flood risk. To meet this duty, Herefordshire Council has completed the PFRA and assessed flood risk from local sources of flooding from surface water, groundwater and ordinary watercourses, together with any interaction with drainage systems, sewers and other sources. The EA is responsible for assessing the risk of flooding from main river, the sea and large reservoirs.

The assessment of local flood risk has involved the collection and review of readily available information held by Herefordshire Council and partners on past floods across Herefordshire. This has been considered in light of national datasets provided by the EA and informed by discussions with the local multi-agency partnership group involving other risk management authorities, including the EA, DCWW/Welsh Water, Severn Trent Water and the River Lugg and Lower Wye Internal Drainage Boards (IDBs). This review has then been supplemented by a detailed and objective assessment of the potential risks of future flooding across the county.

The PFRA has been undertaken using JBA Consulting’s bespoke analytical GIS “Flood Risk Metrics” software (JFrism). This powerful graphical analysis has allowed a comprehensive study of the flood risk facing people, properties and critical infrastructure across Herefordshire. The exposure of these and other vulnerable receptors to a range of local flood sources has been assessed on a 1km grid square basis across the entire county. This has allowed the completion of the PFRA and provided the means to analyse and clearly display the risk from different flood sources on a Parish, Ward or entire County basis. Details of the critical infrastructure and properties at risk will also help inform the Herefordshire Multi-Agency Flood Plan (MFP) and assist in emergency planning.

The PFRA has shown there are 10,357 people, 4,426 residential properties, 5,107 non-residential properties and 241 critical infrastructure sites at risk from surface water flooding across Herefordshire. These figures are derived using the Flood Map for Surface Water (FMfSW) as the locally agreed surface water information. They do not meet the levels used to define areas of "significant flood risk" in the Defra/WAG Guidance and there are no proposals to suggest any amendments. Consequently Herefordshire Council is not required under the Regulations to prepare Flood Hazard and Risk Maps or Flood Risk Management Plans.

The PFRA process has helped strengthen and underline the importance of partnership working and the need for sharing information through the Herefordshire Partnership Group. A comprehensive archive of past floods has been compiled and a database structure now exists to record the mandatory information necessary for documenting all future floods. This will greatly ease the PFRA review process in 6 years time.

Understanding and communicating local flood risk in this way will provide the foundations for developing the Local Flood Risk Management Strategy. This will be developed over the next year as part of the duties under the Flood & Water Management Act 2010. It will define how flood risk is to be assessed and managed across Herefordshire in future years and the PFRA analysis will inform how this future strategy will be taken forward.
Contents

Executive Summary......................................................................................................................... iii
1. Introduction................................................................................................................................. 4
  1.1 Scope of the Report................................................................................................................. 4
  1.2 Objectives and Approach...................................................................................................... 4
  1.3 Study Area .......................................................................................................................... 6
2. Lead Local Flood Authority Responsibilities ................................................................. 8
  2.1 Governance and Partnership............................................................................................... 8
  2.2 Communication..................................................................................................................... 8
3. Methodology and Data Review............................................................................................. 9
  3.1 Information from EA............................................................................................................. 9
  3.2 Information from Herefordshire Council............................................................................. 11
  3.3 Data Availability, Quality and Limitations........................................................................ 11
  3.4 Data Management Systems ............................................................................................... 11
4. Past Flood Risk.......................................................................................................................... 13
  4.1 Introduction ........................................................................................................................ 13
  4.2 Significant Harmful Consequences .................................................................................... 13
  4.3 Past Flood Events............................................................................................................... 14
5. Future Flood Risk..................................................................................................................... 17
  5.1 Introduction ........................................................................................................................ 17
  5.2 Locally Agreed Surface Water Information...................................................................... 18
  5.3 Future Floods and Consequences ..................................................................................... 18
  5.4 The Impacts of Climate Change......................................................................................... 25
  5.5 Significant Local Developments ......................................................................................... 26
6. Identification of Flood Risk Areas ......................................................................................... 27
  6.1 Indicative Flood Risk Areas................................................................................................ 27
  6.2 New Flood Risk Areas......................................................................................................... 27
7. Next Steps................................................................................................................................. 28
  7.1 Review ............................................................................................................................... 28
  7.2 Local Flood Risk Management Strategy........................................................................... 28
Appendices .................................................................................................................................. I
  A.1 Records of past floods and their significant consequences (Preliminary Assessment Report spreadsheet) ............................................................................................................. I
  A.2 Records of future floods and their consequences (Preliminary Assessment Report spreadsheet) ......................................................................................................................... II
  A.3 Records of Flood Risk Areas and their rationale (Preliminary Assessment Report spreadsheet) ..................................................................................................................... III
  A.4 PFRA Review Checklist...................................................................................................... IV
List of Figures

Figure 1.1 Location Plan Showing Indicative Flood Risk Areas and River Basin Boundary. ................................................................. 6
Figure 3.1 Places above Local Flood Risk Threshold ........................................... 13
Figure 5.1 Hotspot Locations within Herefordshire ........................................... 18
Figure 5.2 Residential Properties at Risk of Surface Water Flooding ................. 21
Figure 5.3 Non Residential Properties at Risk of Surface Water Flooding .......... 22
Figure 5.4 Critical Infrastructure at Risk of Surface Water Flooding ................. 23
Figure 5.5 Residential properties at Risk of Surface Water Flooding by Ward .......... 24

List of Tables

Table 3.1: Herefordshire Council Flood Incident Pro-Forma................................. 12
Table 4-1: Notable Past Flood Events in Herefordshire ..................................... 14
Table 4-2: Summary of Past Flood Events ............................................................ 16
Table 5-1: Assessment of Key Flood Risk Indicators ......................................... 19
Table 5-2: Categories of Flood Risk for Local Assessment ................................. 20
## Abbreviations & Glossary

<table>
<thead>
<tr>
<th>Term or Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AONB</td>
<td>Area of Outstanding Natural Beauty</td>
</tr>
<tr>
<td>Assets</td>
<td>Structures, or a system of structures used to manage flood risk</td>
</tr>
<tr>
<td>ASiGWF</td>
<td>Areas Susceptible to Groundwater Flooding</td>
</tr>
<tr>
<td>ASiSWF</td>
<td>Areas Susceptible to Surface Water Flooding</td>
</tr>
<tr>
<td>Catchments</td>
<td>An area that serves a river with rainwater. Every part of land where the rainfall drains to a single watercourse is in the same catchment</td>
</tr>
<tr>
<td>CFMP</td>
<td>Catchment Flood Management Plan</td>
</tr>
<tr>
<td>Cultural heritage</td>
<td>Buildings, structures and landscape features that have an historic value. These are also known as heritage assets</td>
</tr>
<tr>
<td>DCWW</td>
<td>Dwr Cymru Welsh Water</td>
</tr>
<tr>
<td>Defences</td>
<td>A structure that is used to reduce the probability of floodwater or coastal erosion affecting a particular area (for example a raised embankment or sea wall)</td>
</tr>
<tr>
<td>Defra</td>
<td>Department for Environment, Food and Rural Affairs</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EC Inspire Directive</td>
<td>Implemented by the ‘Inspire Regulations 2009’. The main aim being to improve the quality, consistency and accessibility of spatial data sets and services for environmental data</td>
</tr>
<tr>
<td>FCERM</td>
<td>Flood and coastal erosion risk management</td>
</tr>
<tr>
<td>Flood</td>
<td>The temporary covering by water of land not normally covered with water</td>
</tr>
<tr>
<td>FMfSW</td>
<td>Flood Map for Surface Water</td>
</tr>
<tr>
<td>Flood Risk Area</td>
<td>An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG</td>
</tr>
<tr>
<td>FWMA</td>
<td>Flood and Water Management Act</td>
</tr>
<tr>
<td>GHG</td>
<td>Greenhouse Gasses</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information Systems</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Water which is below the surface of the ground and in direct contact with the ground or subsoil</td>
</tr>
<tr>
<td>HSWGW</td>
<td>Historic Surface Water and Groundwater</td>
</tr>
<tr>
<td>IDB</td>
<td>Internal Drainage Board</td>
</tr>
<tr>
<td>Indicative Flood Risk Areas</td>
<td>Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and WAG and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs</td>
</tr>
<tr>
<td>Jfrism</td>
<td>JBA Consulting's bespoke 'Flood Risk Metrics' GIS tool</td>
</tr>
<tr>
<td>LLFA</td>
<td>Lead Local Flood Authority</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Local flood risk</td>
<td>Flood risk from sources other than main rivers, the sea and reservoirs, principally meaning surface runoff, groundwater and ordinary watercourses</td>
</tr>
<tr>
<td>Main River</td>
<td>A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers</td>
</tr>
<tr>
<td>MFP</td>
<td>Herefordshire Multi-Agency Flood Plan</td>
</tr>
<tr>
<td>NRD</td>
<td>National Receptor Dataset – a collection of risk receptors produced by the Environment Agency</td>
</tr>
<tr>
<td>Ordinary Watercourses</td>
<td>All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, IDBs</td>
</tr>
<tr>
<td>Preliminary Assessment Report</td>
<td>A high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding</td>
</tr>
<tr>
<td>Preliminary Assessment Spreadsheet</td>
<td>Reporting spreadsheet which LLFAs need to complete. The spreadsheet will form the basis of the Environment Agency's reporting to the European Commission</td>
</tr>
<tr>
<td>PFRA</td>
<td>Preliminary Flood Risk Assessment</td>
</tr>
<tr>
<td>PPS25</td>
<td>Planning Policy Statement 25</td>
</tr>
<tr>
<td>Receptor</td>
<td>Something that may be harmed by flooding</td>
</tr>
<tr>
<td>Regulations</td>
<td>The Flood Risk Regulations</td>
</tr>
<tr>
<td>Resilience</td>
<td>The ability of the community, services, area or infrastructure to withstand the consequences of an incident</td>
</tr>
<tr>
<td>Risk</td>
<td>Measures the significance of a potential event in terms of likelihood and impact</td>
</tr>
<tr>
<td>River basin district</td>
<td>There are 11 river basin districts in England and Wales, each comprising a number of contiguous river basins or catchments. The Environment Agency is responsible for collating LLFA reports at a river basin district level</td>
</tr>
<tr>
<td>SACs</td>
<td>Special Area of Conservation</td>
</tr>
<tr>
<td>SFRA</td>
<td>Strategic Flood Risk Assessment</td>
</tr>
<tr>
<td>Source</td>
<td>The origin of a hazard (e.g. heavy rainfall, strong winds, surge etc)</td>
</tr>
<tr>
<td>SPAs</td>
<td>Special Protection areas</td>
</tr>
<tr>
<td>SSSIs</td>
<td>Sites of Special Scientific Interest</td>
</tr>
<tr>
<td>Surface runoff</td>
<td>Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer</td>
</tr>
<tr>
<td>SWMP</td>
<td>Surface Water Management Plan</td>
</tr>
<tr>
<td>UKIP09</td>
<td>UK Climate Change Projections 2009</td>
</tr>
<tr>
<td>WAG</td>
<td>Welsh Assembly Government</td>
</tr>
</tbody>
</table>
1. Introduction

1.1 Scope of the Report

Herefordshire Council has new duties as a Lead Local Flood Authority (LLFA) to manage local flood risk across the county. The focus and responsibilities for the council in this new role are to assess and manage local flood risk from sources such as surface water, groundwater and ordinary watercourses. The Environment Agency (EA) is responsible for assessing the risk of flooding from main rivers (such as the River Wye and Lugg), the sea and from large reservoirs.

One of the first obligations is to complete a Preliminary Flood Risk Assessment (PFRA), required as part of the obligations under the Flood Risk Regulations 2009. These Regulations transpose and implement the requirements of the European Floods Directive. This aims to provide a consistent approach to managing flood risk across Europe and to manage and reduce the risks that floods pose to human health, the environment, economic activity and cultural heritage.

This report has been prepared by JBA Consulting for Amey Herefordshire, on behalf of Herefordshire Council. It presents the findings of an assessment of local flood risk and the past and potential future impacts of flooding across Herefordshire. It has to be provided to the Environment Agency (EA) by 22nd June 2011 as part of a national submission to be reviewed and then published and sent to the European Commission in December 2011.

The Flood Risk Regulations 2009 establish a flood risk management framework consisting of four stages that will be reviewed on a 6-yearly basis, namely:

- To prepare a Preliminary Assessment Report on past floods and potential future floods
- To identify Flood Risk Areas (FRAs) where flood risk is deemed nationally significant
- To produce appropriate Flood Hazard and Flood Risk Maps for FRAs
- To prepare Flood Risk Management Plans for FRAs

This Preliminary Assessment Report presents the outcomes of the first two stages that together make up the PFRA process, namely the assessment of local flood risk and the identification of any Flood Risk Areas, where the risk of flooding is considered significant.

The Defra and Welsh Assembly Government guidance sets out the criteria and thresholds for assessing whether a risk of flooding is of national significance. This has confirmed there are no indicative Flood Risk Areas in Herefordshire, based upon the nationally available information. This report includes a review of this determination in respect of any locally held information.

For any agreed Flood Risk Areas where flood risk is deemed significant, these will be subject to the further stages outlined above, namely the preparation of Flood Hazard and Risk Maps by 2013 and the production of Flood Risk Management Plans by 2015.

1.2 Objectives and Approach

The overall aim and objective of the PFRA process is to carry out a high level exercise designed to make use of all existing and readily available data, in order to review past floods and the potential for future floods across Herefordshire.

The key objectives are to:

- Identify partner organisations involved in local flood risk management and engage in the PFRA process through ongoing collaboration
- Establish agreed systems for future data management, sharing and storage
• Describe the adopted approach to the PFRA
• Undertake an assessment of past floods across Herefordshire from local sources of flooding and summarise the consequences and impacts of these events
• Assess the potential harmful consequences of future flood events within the county
• Review and update the county-wide system to enable the recording of all relevant information for future floods
• Review the provisional national assessment of indicative Flood Risk Areas provided by the EA and provide explanation and justification for any amendments required to the Flood Risk Areas.

The assessment of local flood risk has involved the collection and review of readily available information held by Herefordshire Council and partners on past floods across Herefordshire. This has been considered in light of national datasets provided by the EA and further informed by discussions with the Herefordshire Flood Risk Management Partnership group, involving other risk management authorities, including the EA, DCWW/Welsh Water, Severn Trent Water and the River Lugg, Lower Severn and Lower Wye Internal Drainage Boards (IDBs).

This review has then been supplemented by a detailed and objective assessment of the potential risks of future flooding across the county. This has been undertaken using JBA Consulting's bespoke GIS analytical "Flood Risk Metrics" software ("JFrism"), which allows a detailed assessment of the risk from local flood sources to a wide range of receptors and at differing threshold levels. This has helped with the consideration of significant flood risk and the identification of any Flood Risk Areas. It has also provided Herefordshire Council with a powerful graphical tool that helps understand and communicate a range of flood risks across the county, capable of being presented at a Parish, Ward or County-wide basis. The decision was taken to invest in and use these GIS tools in order to not only ensure the analysis delivered both the PFRA that is required now, but to also gain efficiencies and avoid duplication of efforts in the preparation of future flood management strategies across the county.

Understanding and communicating local flood risk in this way will provide the foundations for developing the Herefordshire Council's Local Flood Risk Management Strategy. Work on this will be commencing later this year, once the National FCERM Strategy has been published, as part of the duties under the Flood & Water Management Act 2010. The Local Flood Risk Management Strategy will define how flood risk is to be assessed and managed across Herefordshire in future years. The PFRA analysis has therefore also been used as an opportunity to inform how this future strategy will be taken forward.

The PFRA process is also an opportunity to review, strengthen and promote local partnership and information sharing arrangements between the local risk management authorities. It represents one of the first activities to be performed in accordance with the new requirements established under the Flood & Water Management Act 2010. A further outcome of this work is that there will be an improved data management system. Roles and responsibilities of operating authorities have now been clarified, as has the need for partner organisations to cooperate and share data and information in a spirit of partnership. This delivers on two of the central recommendations of the Pitt Review into the Summer 2007 floods.

A further objective and outcome of this work is for there to be an agreed data management system that will be used by Herefordshire Council for recording all the critical information relating to all future floods that occur across the county. Records of past floods held by the Council and others have been reviewed and consolidated into the attached spreadsheet contained in Annex 1. This includes a number of mandatory fields that are required and provide the template for the new system such that all flood events are thoroughly recorded in the future. This will ensure that comprehensive records are collected and recorded in the correct format, greatly simplifying the future revision of the PFRA and updating of "past floods" which will be required in 6 years time.
1.3 Study Area

The Unitary County of Herefordshire is located on the Welsh Borders, in the south westerly corner of the West Midlands region (Figure 1.1). It is an area known for its unspoilt countryside, with numerous Areas of Outstanding Natural Beauty (AONB) and Sites of Special Scientific Significance (SSSI) certifications throughout the county. It is bordered to the west by Wales and the Black Mountains, to the east by the Malvern Hills AONB and to the south by the Lower Wye Valley AONB.

![Figure 1.1 Location Plan Showing Indicative Flood Risk Areas and River Basin Boundary.](image)

The county lies wholly within the Severn River Basin District as defined by the EC Water Framework Directive. The River Wye is the primary river which flows into and through the county from the west, before being joined by the River Lugg and River Arrow which flow from the north. The characteristic red sandy soil type in the area is derived from the extensive underlying Old Red Sandstone, although limestone and mudstone outcrops are also common.

The county as a whole has a total land area of approximately 2,183 km², and has an estimated population of 179,100 people. The population density for the county is very low at 80 people per km². According to the Office for National Statistics, this is the 4th lowest found throughout England. Hereford City is the main economic hub of the county; it is the centre for education, health, shopping, employment and population with just under one third of all residences concentrated here. The historic market towns of Leominster, Ledbury, Ross, Bromyard and Kington follow Hereford City in size and between them account for around one
fifth of the population. The remaining 50% of people reside in smaller towns, villages and hamlets, as well as in isolated dwellings and farms throughout the county.

Principal risk management authority partners in the area, other than the EA, include the water companies and the local Internal Drainage Boards. Herefordshire Council already coordinate and chair periodic partnership meetings involving all the relevant local operating authorities. The area primarily falls within the Welsh Water/DCWW water supply and treatment area, although a small area in the north-eastern corner of the county is served by Severn Trent Water. The relatively flat area of the River Lugg floodplain north-east of Hereford is managed and operated by the River Lugg Internal Drainage Board (IDB).
2. Lead Local Flood Authority Responsibilities

2.1 Governance and Partnership

The Flood & Water Management Act 2010 has defined an enhanced role for local authorities so that they take on the responsibility for leading the co-ordination of flood risk management in their area. Herefordshire Council, as one such Lead Local Flood Authority (LLFA), is responsible for all local flood risk management within the County. This includes flooding which primarily originates from ordinary watercourses, surface water and groundwater sources, as well as any interactions between all sources of flooding, such as from main rivers, where these could impact upon local sources.

These new duties also define the EA as the responsible body for the management of flood risk from main rivers, large reservoirs and the sea. The EA is also responsible for providing a strategic overview on all flood risk matters.

Partnership working between all the risk management authorities has been recognised as of the upmost importance for effective flood risk management. Duties to co-operate and share information are now included in the Act and the Regulations. These responsibilities now form a central principal in the delivery of the PFRA and the future development of the Herefordshire Local Flood Risk Management Strategy.

It is recognised that it is essential for all stakeholders - such as neighbouring authorities, the EA, Internal Drainage Boards (IDBs), and Water Companies - to be fully engaged and working together to fully understand any flood risk issues that may impact upon the County. The council has already established the multi-agency Herefordshire Flood Risk Management Partnership and will be co-ordinating regular partnership meetings in the future within the County.

The Herefordshire Flood Risk Management Partnership will play a crucial role in the future delivery of local flood risk management services. It has been considered that such partnership working helps facilitate more effective communications with residents at flood risk, as well as provide more co-ordinated emergency response plans and longer term management strategies. It provides the integrated approach as originally recommended by the Pitt Review, helping to deliver the PFRA now and to prepare the foundations to the Local Flood Risk Management Strategy required in the future.

2.2 Communication

The Herefordshire Flood Risk Management Partnership provides the forum for regular liaison and communication with local risk management authorities. These meetings are chaired and co-ordinated by Herefordshire Council, helping to clarify roles and responsibilities as well as to plan for the effective future management of local flood risk. They provide an opportunity for partners to share data, information and knowledge, and to agree a co-ordinated plan of flood management and response. This partnership approach helps to optimise locally available resources and experience, as well as to identify funding opportunities and agree local flood risk management priorities.

This forum provides the opportunity to communicate this shared understanding and the agreed management actions across the council and between partner organisations. It also enables the vital link to be made with local communities and members of the public directly affected and at flood risk.

Communication with the public can also be achieved through on-line feedback forms, particularly useful immediately after a flood event. There is the intention to increase dialogue with the public following flood event surveys aimed at gathering information from members of the public about either a very recent flood or perhaps capturing knowledge and experience of past floods.
3. Methodology and Data Review

3.1 Information from EA

The methodology for undertaking this PFRA is based upon the national guidance prepared by the EA and the Ministerial Guidance produced by Defra and WAG. The latter provides the thresholds and criteria used for determining Flood Risk Areas where the risk of flooding is identified as significant. The EA guidance has explained the technical detail behind the PFRA, the form of the report and how to apply the Defra/WAG guidance on significant risk.

The EA has also provided CDs containing supporting information and made available national datasets distributed via DataShare. This information has included:

- Maps, spreadsheets and GIS layers of all places above local flood risk thresholds (Figure 3.1 - the "blue squares" map) and the clusters then created in determining Flood Risk Areas
- Details on the consequences of flooding to historic assets and Pollution, Prevention & Control (PPC) sites

Two national datasets showing surface water flooding extents have been made available by the EA to LLFAs, namely:

- Areas Susceptible to Surface Water Flooding map (ASTSWF) - derived from one rainfall event with three susceptibility bandings: less, intermediate and more.
- Flood Map for Surface Water (FMfSW) - derived from two rainfall events dividing into two depth bandings: 1:200 rainfall and 1:200 rainfall deep, as well as 1:30 rainfall and 1:30 rainfall deep.

There are also four national datasets on groundwater flooding detailed in the EA guidance, including the Areas Susceptible to Groundwater Flooding broad-scale map.

In addition, there are details on DataShare of information on past floods, including the Historic Flood Map and Flood Event Outlines, although primarily focussing on flooding from main river and the sea. The Historic Surface Water and Groundwater (HSWGW) Geodatabase has not been available, although this does contain some records originally submitted by local authorities.

Whilst the information above all relates to differing flood sources and records of past events, another key dataset provided by the EA and used in the PFRA is the National Receptor Dataset (NRD). This relates to receptor vulnerability to flooding and provides details of social, economic, environmental and cultural receptors including residential properties, hospitals, schools, electricity sub-stations and critical transport infrastructure.

It can be seen from Figure 3.1 that the places where the national thresholds for residential, non-residential and critical infrastructure are exceeded include Hereford City, Ledbury, Bromyard, Ross-on-Wye and Leominster together with other local hotspots.
Based on the Flood Map for Surface Water (200 year Deep) which indicates the chance of land flooding to a depth greater than 0.3m during a 1 in 200 year rainfall event.

Legend
- Herefordshire County Boundary
- Hotspots

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below (using NRD v1.0):
1. Number of People > 200
2. Critical Services > 1
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency’s detailed method of counting (based on property outlines).

Figure 3.1
Places Above Flood Risk Threshold

Drawn by: Bethlyn Jones
Date: 25/05/2011
Status: Final
Drawing Number: Figure 3.1
OS Licence: Contains Ordnance Survey data © Crown copyright and database right 2011
3.2 Information from Herefordshire Council

Locally held data and information on past flooding has been collected over the years and has now been consolidated into an archive of flood records. The most comprehensive source of information was contained within the Herefordshire Councils' database of past flood events, drawn from reports received from members of the public, from records held by the Highways Department and within Amey Herefordshire. In addition, some records held by the Fire Service have also been incorporated into the database.

This database has provided the primary resource for the PFRA. However these records had some limitations and were often incomplete so they have been further refined and consolidated into the revised spreadsheet.

This main source of flood event information has been supplemented where possible with records and information from Welsh Water/DCWW, Severn Trent Water and the River Lugg and the Lower Wye IDBs. The Water Companies hold records of historic sewer flooding incidents in each area on their respective DG5 Registers, made available to Amey Herefordshire under the terms of a confidentiality agreement. Although these records have not been used in the production of this PFRA, they will provide additional useful information for the Herefordshire Flood Risk Management Partnership to consider in the preparation of the Local Flood Risk Management Strategy.

In addition, reference has been made to the comprehensive Strategic Flood Risk Assessment (SFRA) prepared for Herefordshire in 2009.

3.3 Data Availability, Quality and Limitations

Much of the data provided by the EA has been made available under licence to the LLFAs. This data has, in turn, been licensed for use by both Amey Herefordshire and by JBA Consulting in preparing the PFRA.

The council's flood events database provided the main source of information on past floods. Quality assurance checks have been carried out on the archive of past floods, in order to exclude inaccurate or incomplete records. This was found to contain many entries for events with only partial information included and many with numerous fields marked as "unknown". Often the source of flooding was unattributed and frequently the location was too imprecise to be able to be included in the analysis. Of the 158 entries, around 40 were excluded on the grounds of these limitations. This has improved the quality and reliability of our information on past floods, helping to better inform our response to future floods.

Further analysis of the remaining records revealed that many could be aggregated into common events that appear related to the same flooding episode. This process helped consolidate the 118 remaining entries down to 14 identified flood event dates. These are summarised in Section 4.3 below.

3.4 Data Management Systems

The process of collecting and consolidating information and records on past floods has allowed the flood event and data storage system established by the council to be reviewed. This will allow the existing Herefordshire Council database to be modified, to ensure consistency with the PFRA reporting template set out by the EA in Annex 1 to this Preliminary Assessment Report. Mandatory fields within the PFRA reporting template are included as well as some of the additional fields that are likely to be required in the future.

A Flood Incident Reporting Pro-forma has been produced by Herefordshire Council, reproduced in Table 3.1.
Table 3.1: Herefordshire Council Flood Incident Pro-Forma

This will ensure all the required information on flood events is captured in the future, recorded in the correct format for direct input to future PFRA reviews. This will greatly simplify and make for a more efficient means of submitting the required information on past floods. It will also ensure all local flood events are captured and assessed. This system will be shared both right across the various council departments and within the Herefordshire Flood Risk Management Partnership, enabling interchange of data and the recording of all flood events, regardless of responsibility or source. At its heart is the agreement for sharing data and information and recording flood event information in a consistent and complete manner, providing an invaluable archive of quality assured flood records.

Information from the sewer flooding register maintained by the water companies has not as yet been added or used in the PFRA. This will be considered as local issues are investigated as part of the Local Flood Risk Management Strategy to be progressed later in the year.
4. Past Flood Risk

4.1 Introduction

This section summarises the relevant information collected and analysed on past floods within the county from local flood sources. This has been derived from the records described in Section 3 above and is presented in the required format in Annex 1 of this report.

The Flood Risk Regulations refer to past floods which had "significant harmful consequences". However, while "significant" has been defined in terms of national risk used to identify Flood Risk Areas, there is no such definition in terms of past floods from local sources. The guidance leaves this for individual LLFAs to determine as circumstances and approaches vary.

4.2 Significant Harmful Consequences

The information provided by the EA shows there are numerous "blue squares" across Herefordshire where flood risk from surface water in any 1km² grid square exceeds the nationally defined thresholds. However, the subsequent clustering process described in the Defra/WAG Guidance results in there being no Flood Risk Areas within Herefordshire.

Whilst there may not be any areas of nationally significant flood risk, there are many areas where local flood risk has been an issue in the past and remains a risk in the future. The PFRA analysis has therefore been carried out focussing on these areas, utilising the JBA Consulting "Flood Risk Metrics" (JFrism) GIS tools to replicate the national analysis and to consider remaining areas across the county.

In considering thresholds for local flood risk across Herefordshire, emphasis has been placed upon ensuring the PFRA process is used to also inform and provide a consistent basis and foundation for the forthcoming Local Flood Risk Management Strategy. There are efficiencies to be gained from dovetailing the two processes and ensuring one consistent approach. This will also avoid any unnecessary duplication of effort.

Consequently the approach adopted for the PFRA reflects this integrated approach. The information requested in the Herefordshire Council "Flood Incident Reporting Pro-forma" shown in Table 3.1 provides a consistent and comprehensive template that helps populate the spreadsheet included in Annex 1. This will help capture the important information for all future flood events and form the basis for all future flood event recording. The information can then be transferred to a single archive database system, to provide a comprehensive data source for future PFRA revisions. Comprehensive flood records will also inform and help the development and ongoing maintenance of the Local Flood Risk Management Strategy.

Flooding is a traumatic, damaging and potentially life threatening event. Flood events will vary in scale according to the extent and intensity of the rainfall. Whilst the major events will capture the media headlines, smaller events are also important to understand as these could be pointers and an early alarm of problems with the drainage infrastructure, such as asset condition, blocked or collapsing culverts etc.

Information on all past flood events has been scrutinised and assessed. Unreliable or incomplete records have been omitted, to ensure the archive contains the best available information and to provide increased confidence in the record of past floods.
4.3 Past Flood Events

The list of past flood events and details of associated consequences is presented in Annex 1. From the many individual entries contained in the original database, an archive of 14 distinct flood events has been prepared dating back to 1965. For each event, details have been provided of the source, location and extent of the flooding. For each event, the human health, economic, environmental and cultural heritage impacts and consequences are detailed where known.

These events record flooding that, for the most part, was caused by natural exceedance from either excessive surface water runoff, or from ordinary watercourse flooding often in combination with flooding from main rivers. The events were generally short lived (around one day) as is characteristic with surface water flooding, although periods of river flooding lasted longer.

Some of the most notable events are listed below in Table 4-1, with the July 2007 floods as the most extensive and damaging.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>No. Of Residential Properties Affected</th>
<th>Source of Flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 1979</td>
<td>North West Herefordshire</td>
<td>18</td>
<td>Ordinary Watercourse</td>
</tr>
<tr>
<td>Jan 1986</td>
<td>Eardisland</td>
<td>42</td>
<td>Ordinary Watercourse</td>
</tr>
<tr>
<td>Oct 1998</td>
<td>County-wide</td>
<td>70</td>
<td>Main River and Ordinary Watercourse</td>
</tr>
<tr>
<td>Aug 2006</td>
<td>Ross-on-Wye</td>
<td>20</td>
<td>Main River</td>
</tr>
<tr>
<td>July 2007</td>
<td>County-wide</td>
<td>309</td>
<td>Main River, Ordinary Watercourse ad Surface Water</td>
</tr>
</tbody>
</table>

Table 4-1: Notable Past Flood Events in Herefordshire

Further details of these and other past floods and their consequences are summarised in Table 4-2 below and contained in Annex 1 in full. In compiling this record, full reference was made to the Herefordshire SFRA, to ensure consistency and completeness.

The SFRA has also researched and listed the main or notable flood events across the county. However, most of these relate to flood events on main rivers, in particular the River Wye and the tributary Rivers Lugg and Teme and have therefore been excluded from this assessment. However there are some events affecting ordinary watercourses, such as the River Arrow at Titley Mill, Eardisland in January 1986. Widespread surface water flooding also occurred across the county during the July 2007 floods although often in conjunction with main river flooding as well.
<table>
<thead>
<tr>
<th>Date</th>
<th>Flood Details</th>
<th>Consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>19/01/1965</td>
<td>Details surrounding event are limited. 6 properties located along Millbrook lane were flooded due to fluvial discharge from the Mill Brook.</td>
<td>6 residential properties.</td>
</tr>
<tr>
<td>26/12/1979</td>
<td>Details of the event are limited however it is understood that an extreme rainfall event continued for a number of days, causing flooding across the county. Increased levels of surface water runoff combined with fluvial discharge, surcharging drains and groundwater to cause flooding to at least 18 properties and various roads, mainly affecting the villages of Peterchurch and Pontrilas in the south and Canon Pyon, Eardisland, Eardisley and Richards Castle located in the North west of the County. Wellington Brook and River Arrow named as sources of flood.</td>
<td>18 residential properties; road flooding to C1033, A4111/U90633 and B4361.</td>
</tr>
<tr>
<td>05/06/1985</td>
<td>Details surrounding event are limited. 2 properties flooded due to discharge from Cage Brook combined with increased surface water runoff and poor drainage.</td>
<td>2 residential properties.</td>
</tr>
<tr>
<td>10/01/1986</td>
<td>Details of the event are limited, however it is understood that fluvial discharge from the River Arrow combined with surface water runoff to cause flooding to 42 properties in the Eardisland, Hentland and Pembridge areas. The village of Eardisland is located on the natural flood plain of the River Arrow.</td>
<td>42 residential properties; road flooding to the U93012.</td>
</tr>
<tr>
<td>19/05/1986</td>
<td>Details of the event are limited. It is understood that fluvial discharge from the River Wye caused flooding to 1 property located in the village of Hoarwithy. A tributary of the River Wye, Wriggles Brook flows past the property called the Old Mill. This may in fact be the cause of flooding.</td>
<td>1 residential property.</td>
</tr>
<tr>
<td>28/12/1994</td>
<td>Event details are limited. Flooding of 3 properties and numerous roads due to main river discharge (River Wye) as well as increased surface water runoff which caused storm and surface water drains to backflow.</td>
<td>3 residential properties; road flooding to the A49, U82323/U82345 and A438.</td>
</tr>
<tr>
<td>08/04/1998</td>
<td>On the 08th of April 1998 heavy rain caused flooding to the centre of Ledbury and neighbouring Bosbury. Several roads were closed, although it is not clear for how long. Flooding occurred as a result of increased surface water runoff which exceeded the drainage capacity in some places and also fluvial flooding due to the River Leaton overtopping its banks. Numerous other villages affected, including Wellington, Withington Marsh, Bodenham and Moreton Camp.</td>
<td>3 residential properties; road flooding to the B4220, C1152 and C1308.</td>
</tr>
<tr>
<td>28/10/1998</td>
<td>Details surrounding the event are limited however during October 1998 a number of rainfall events occurred in close succession. Soil moisture deficits were greatly reduced as a result of these events, with the continued rain causing river levels to rise also. It is known that on the 28/10/1998 the River Wye reached its peak and overtopped its banks. Flood incident reports have been obtained which state that the centre of Hereford was flooded at this time, as well as properties in the village of Stapleton. The village of Stapleton reported to have been flooded by the River Lugg, a tributary of the River Wye.</td>
<td>70 residential properties; 2 non-residential properties; road flooding to the C1004.</td>
</tr>
<tr>
<td>16/01/1999</td>
<td>Details surrounding flood event are limited. It is understood that on the 16th January 1999 flooding occurred in the area of Hoarwithy Road, affecting 1 property and the road itself. Flooding originated from Withy Brook as well as surface water runoff and groundwater.</td>
<td>1 residential property; road flooding to Hoarwithy Road.</td>
</tr>
<tr>
<td>Date</td>
<td>Details</td>
<td>Properties</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>14/02/2000</td>
<td>Details surrounding this event are limited. It is understood that Ashburton Industrial Estate located in Ross on Wye suffered from fluvial flooding originating from the Rudhall Brook on the 14th of February 2000. There were no reports of residential flooding however a number of non-residential, business units were affected.</td>
<td>An unknown number of non-residential business units located on Ashburton Industrial Estate.</td>
</tr>
<tr>
<td>08/12/2000</td>
<td>Details surrounding this event are limited however on this date there was widespread flooding throughout the south of the UK due to an intense storm. Within Herefordshire, the areas of Peterchurch and Ross on Wye were affected.</td>
<td>7 residential properties; 1 non-residential property.</td>
</tr>
<tr>
<td>23/08/2006</td>
<td>Details surrounding this event are limited however it is understood that a very heavy storm event took place on the 23rd August 2006 which was the cause of flooding to Brookend Street located in Ross on Wye. 20 properties are thought to have flooded during this event. News reports indicated that a number of businesses also flooded however this is not clear from the information in the flood reports.</td>
<td>20 residential properties.</td>
</tr>
<tr>
<td>20/07/2007</td>
<td>The period between May and July of 2007 is reported to have been the wettest since records began, with a number of heavy rainfall events occurring in close succession. On the 20th of July an active frontal system moved across southern England, bringing with it heavy rainfall which inundated the already saturated ground. River networks were overloaded and overtopping occurred from various main rivers and ordinary watercourses which combined with extremely high levels of surface water runoff and groundwater, resulting in drainage systems to back up and flooding to occur throughout the County of Herefordshire.</td>
<td>309 residential properties; 4 Primary Schools; 16 non-residential properties; 1 Caravan Park.</td>
</tr>
<tr>
<td>20/07/2010</td>
<td>Details surrounding this flood event are limited. On the 20th of July 2010, Moor Brook exceeded its capacity and overtopped its banks which caused flooding to 2 roads and 1 property. Land drainage capacities were also exceeded.</td>
<td>1 residential property; road flooding to the U93001 and U93003.</td>
</tr>
</tbody>
</table>

Table 4-2: Summary of Past Flood Events
5. Future Flood Risk

5.1 Introduction

This section of the report summarises all relevant information on future floods and provides an essential foundation for informing future flood risk strategies across the county.

The national guidance issued by Defra and WAG sets out the criteria used for defining significant flood risk and the Flood Risk Areas. In developing the methodology for assessing flood risk, threshold levels were defined for the key Flood Risk Indicators as follows:

- Number of People > 200,
- Non-Residential Properties > 20,
- Critical Infrastructure > 1

This process resulted in maps of 'Hotspots' or places above the thresholds, defined where 1 km grid squares meet the significance level set for at least one of the key Flood Risk Indicators shown above. These Hotspots are shown in Figure 5.1 for Herefordshire.

Where 5 or more "hotspots" are touching within a 3km$^2$ roving grid, they are deemed to form a cluster. Where the number of people at risk within a cluster is greater than 30,000 in England, this has then been classed as an "indicative Flood Risk Area". Ten such indicative FRAs have been so defined in England and eight in Wales (see Figure 1.1). The criteria in Wales are set at lower levels of 5000 people within clusters formed where 4 or more blue squares touch. This reflects the extensive rural nature and lower population density in Wales.

No indicative Flood Risk Areas have been identified for the County of Herefordshire; however local future flood risk must still be assessed as part of the PFRA process.

Some differences have been observed between the nationally supplied data shown in Figure 3.1 and that of the data recalculated for the purposes of this PFRA in Figure 5.1. These arise primarily due to the version of the National Receptor Dataset (NRD) used. At the time that the national calculations were completed, NRD Version 1.0 was the most up to date. However, since this time, Version 1.1 has been released which includes a greater amount of properties within it, along with a more accurate representation of building classification. The number of properties affected by surface water flooding has therefore naturally increased.

In addition to this, the Environment Agency classification of critical infrastructure specified that the following building types should be removed from the data before analysis begins:

- Electricity Sub Station,
- Sewage Filtration,
- Sewage Outfall,
- Sewage Pump House,
- Sewage Recycling,
- Sewage Storage,
- Sewage Treatment.

This was discussed with Amey Herefordshire and it was decided that these features are of local importance and should remain and be counted as part of the critical infrastructure. The outcome will prove important when considering local strategies as well as in preparing and responding to flood emergencies.
5.2 Locally Agreed Surface Water Information

In order to determine the 'locally agreed surface water information', known areas of surface water flooding and local knowledge have been considered and comparisons made with the surface water flood maps available.

Whilst these maps are indicative and are not for determining individual property risks, it was concluded that the more recent FMfSW map provides the most detailed and informative picture of risk. This has therefore been used in the analysis of future flood risk as the locally agreed surface water information. However the ASISWF map will also be retained and considered in future flood risk assessments as well, in particular as it is deemed to provide a more accurate representation of risk in the flat, low-lying areas such as the River Lugg IDB floodplain areas.

5.3 Future Floods and Consequences

Annex 2 has been completed after a thorough analysis of future flood risk. It contains extensive details of future flood risk, possible adverse consequences and impacts across Herefordshire.

Future flood risk has been assessed predominantly using NRD data (version 1.1), supplied to JBA Consulting by Herefordshire Council. To replicate the nationally provided data, flood risk indicators have been calculated using building outlines where appropriate. To derive the number of people at risk of flooding within a given area, building outline counts were then multiplied by a factor of 2.34, which is the nationally agreed average occupancy per household.
Flood risk indicators have then been assessed using "JFrism" for each of the principal sources of mapped flood risk information, in particular for surface water flood risk. Table 5-1 summarises information in Annex 2 and shows the key flood risk indicators and the counts derived for both the Areas Susceptible to Surface Water Flooding (1st Generation Surface Water Map - ASTSWF) and the Flood Map for Surface Water Flooding (2nd Generation Surface Water Map) - FMFSW.

<table>
<thead>
<tr>
<th>Flood Outline</th>
<th>Residential Properties at Flood Risk</th>
<th>No. of People at Flood Risk</th>
<th>Critical Infrastructure at Flood Risk</th>
<th>Non Residential Properties at Flood Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTSWF - Less</td>
<td>12,800</td>
<td>30,000</td>
<td>500</td>
<td>10,400</td>
</tr>
<tr>
<td>ASTSWF - Intermediate</td>
<td>5,700</td>
<td>13,300</td>
<td>300</td>
<td>5,400</td>
</tr>
<tr>
<td>ASTSWF - More</td>
<td>900</td>
<td>2,100</td>
<td>100</td>
<td>1,000</td>
</tr>
<tr>
<td>FMFSW - 30 year</td>
<td>6,400</td>
<td>15,000</td>
<td>300</td>
<td>7,900</td>
</tr>
<tr>
<td>FMFSW - 200 year</td>
<td>1,800</td>
<td>4,200</td>
<td>100</td>
<td>2,700</td>
</tr>
<tr>
<td>FMFSW - 200 year Deep</td>
<td>14,200</td>
<td>33,200</td>
<td>500</td>
<td>13,200</td>
</tr>
<tr>
<td>*FMFSW - 200 year Deep</td>
<td>4,400</td>
<td>10,300</td>
<td>200</td>
<td>5,100</td>
</tr>
<tr>
<td>ASTGWF</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Flood Zone 3</td>
<td>6,100</td>
<td>14,300</td>
<td>300</td>
<td>4,600</td>
</tr>
<tr>
<td>Flood Zone 2</td>
<td>8,200</td>
<td>19,200</td>
<td>300</td>
<td>5,800</td>
</tr>
</tbody>
</table>

Table 5-1: Assessment of Key Flood Risk Indicators
*Locally agreed surface water information - rounded to nearest 100

As Table 5-1 illustrates, the key flood risk indicators have also been assessed in respect of the Areas Susceptible to Groundwater Flooding map (ASTGWF). However this information is both very broad scale and only really addresses locations of alluvial drift. It is known that there are very few instances of groundwater flooding and that these are in general also associated with areas of surface water flooding. It is therefore important to note that the results that have to be reported in Annex 2 provide an unreliable and inaccurate picture, reporting incorrectly in excess of 150,000 people are apparently at risk. This is nearly the entire population of the county and therefore clearly incorrect. Consequently it is recommended these counts are not taken forward in any future assessment until more detailed local assessments are available.

The assessment of future flood risk was also extended to include the EA main river Flood Zones 2 and 3. These were considered to help the understanding of any interactions that may take place between local flood sources of risk and main river. However the EA is responsible for main river assessments rather than the LLFA, so this has not been considered further other than to determine possible interactions.

This detailed analysis has been derived using JBA Consulting's bespoke analytical GIS software (JFRIsm). This powerful graphical analysis tool has allowed a comprehensive study of the risk facing people, properties and critical infrastructure across Herefordshire. The exposure of these and other vulnerable receptors to a range of local flood sources has been assessed on a 1km grid square basis across the entire county, also allowing for in depth analysis and interrogation of the data.

As has been stated, the PFRA stage of the Regulations has also been used to provide the basis for a flood assessment for the local strategy. Whilst national thresholds have been established for the key flood risk indicators to define significance (see Section 5.1 above), LLFAs are encouraged to consider the full range of local flood risk across their area in addition to any areas of “significant risk”. In view of the flooding issues across the county, a
further set of thresholds for residential properties - and therefore people - at risk of surface water flooding has been established. This provides additional categories of "low", "medium" and "high" risk below that of "significant". In this way, the scale of risk and consequence can be assessed and prioritised in an inclusive way right across Herefordshire.

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>NUMBER OF PEOPLE</th>
<th>NUMBER OF PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW RISK</td>
<td>&gt;1 – 20 people</td>
<td>1 - 9 properties</td>
</tr>
<tr>
<td>MEDIUM RISK</td>
<td>21-99 people</td>
<td>10 - 42 properties</td>
</tr>
<tr>
<td>HIGH RISK</td>
<td>100-199 people</td>
<td>43 - 85 properties</td>
</tr>
<tr>
<td>SIGNIFICANT RISK</td>
<td>&gt;200 people</td>
<td>&gt;85 properties</td>
</tr>
</tbody>
</table>

Table 5-2: Categories of Flood Risk for Local Assessment

Using these locally applied thresholds, it is possible to analyse and produce an extensive suite of maps, to illustrate a range of flood sources affecting different indicators. Furthermore, these can be presented at any scale and on a Parish, Ward or County-wide basis. This will be of value in taking the management of flood risk forward in preparing the local strategy.

Figures 5.2 to 5.5 illustrate the range of maps produced as part of the PFRA process, using the Flood Map for Surface Water 200 year Deep scenario.

Figure 5.2 (Residential Properties at Risk of Surface Water Flooding), identifies that there is significant risk of surface water flooding to residential properties located within Hereford City as well as the market towns of Ledbury, Ross-on-Wye and Bromyard. Bromyard is in fact at greatest risk of surface water flooding, with 197 residential properties at risk within a single kilometre grid square. The greatest risk to non-residential properties is however located within Ledbury, (Figure 5.3), with significant risk of surface water flooding again perceived within Hereford City, Ross-on-Wye and Bromyard; as well as Leominster and Kington.

Figure 5.4 shows a fairly even distribution of critical infrastructure sites at risk of surface water flooding throughout the county. The grid square containing the greatest number of critical infrastructure features at risk is located in the north-east of Herefordshire where a number of communication masts are focussed within 1 km grid square. Greater details of the infrastructure thought to be at risk are included in Annex 2. This provides the basis to verify the actual features at risk in more detail and undertake a ground survey exercise to confirm and manage these risks. The resulting information can then be used to inform the Herefordshire Multi-agency Flood Plan and any protective works necessary to reduce the risk.

On a Ward basis, Figure 5.5 shows that Ledbury, Bromyard, Three Elms, Aylestone and St. Martins & Hinton Wards are all deemed to be at significant risk of surface water flooding to residential properties. Detailed analysis is possible for any Ward or Parish: for example within the Ledbury Ward, there are 331 residential properties at flood risk, with 217 of these properties concentrated within the centre, around the Ledbury Park area.

The range of maps and analyses possible illustrate how flood risk can be assessed and represented at differing scales across the county. Such localised assessment will be helpful when developing the Local Flood Risk Management Strategy and managing the risks identified.
Richmond

Residential Buildings At Risk Of Surface Water Flooding

Legend

- Herefordshire County Boundary
- Hotspot

Human Health:
Residential Buildings
- None
- Low Risk (0.01 - 9.99)
- Medium Risk (10 - 42.99)
- High Risk (43 - 85.5)
- Significant (85.51 - 197)

Based on the Flood Map for Surface Water (200 year Deep) which indicates the chance of land flooding to a depth of greater than 0.3m during a 1 in 200 year rainfall event.

Sub-Connections
- Hotspots are 1 km grid squares where at least one of the following flood risk indicators is above the threshold given below:
  1. Number of People > 200
  2. Critical Services > 1
  3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency’s detailed method of counting (based on property outlines).
PFRA Analysis
County of Herefordshire

Non Residential Buildings At Risk Of Surface Water Flooding

Based on the Flood Map for Surface Water (200 year Deep) which indicates the chance of land flooding to a depth of greater than 0.3m during a 1 in 200 year rainfall event.

Legend

- Herefordshire County Boundary
- Hotspot

Economic:

- Non Residential Buildings
  - None
  - Low Risk (0.01 - 9.99)
  - Medium Risk (10 - 14.99)
  - High Risk (15 - 19.99)
  - Significant (20 - 95)

Hotspots are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of People > 200
2. Critical Services > 1
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency’s detailed method of counting (based on property outlines).

Figure 5.3

Based on the Flood Map for Surface Water (200 year Deep) which indicates the chance of land flooding to a depth of greater than 0.3m during a 1 in 200 year rainfall event.
Critical Infrastructure At Risk Of Surface Water Flooding

Herefordshire County Boundary

Hotspot

Human Health:

Critical Infrastructure

None

Low Risk (0.01 - 0.97)

Medium Risk (0.98)

High Risk (0.99)

Significant (1 - 17)

Indicators calculated using the Environment Agency’s detailed method of counting (based on property outlines).

Legend

Based on the Flood Map for Surface Water (200 year Deep) which indicates the chance of land flooding to a depth of greater than 0.3m during a 1 in 200 year rainfall event.

Drawn by: Bethlyn Jones

Date: 25/05/2011

Status: Final

Drawing Number: Figure 5.4

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OS Licence:
Residential Buildings At Risk Of Surface Water Flooding

Based on the Flood Map for Surface Water (200 year Deep) which indicates the chance of land flooding to a depth of greater than 0.3m during a 1 in 200 year rainfall event.

Legend
- Herefordshire County Boundary
- Ward Boundaries

Human Health: Residential Buildings at Risk of Surface Water Flooding
- None
- 0.01 - 49.99
- 50 - 99.99
- 100 - 199.99
- 200 - 331

Indicators calculated using the Environment Agency’s detailed method of counting (based on property outlines).

ID Number  Ward         ID Number  Ward
   1     Aylestone     21    Ledbury
   2     Blockbury     22    Leominster North
   3     Belmont       23    Leominster South
   4     Bircher       24    Longnor
   5     Bringsty      25    Moreton
   6     Bromyard      26    Old Town
   7     Burghill, Holmer & Lyde 27    Pontrilas & Llwydch
   8     Castle        28    Penyard
   9     Cadair        29    Pontes
  10     Credenhill    30    Ross-on-Wye East
  11     Craven         31    Ross-on-Wye West
  12     Crossbridge   32    St. Martins
  13     Crossways     33    St. Nicholas
  14     Crickhowell   34    Stoney Street
  15     Crimdon       35    Sutton Walls
  16     Hampton Court 36    Three Elms
  17     Hollington    37    Tupsley
  18     Hope End      38    Upton
  19     Kerne Bridge  39    Valletts
  20     Kington Town  40    Warnesley Ridge
  21     Ledbury North
  22     Leominster South
  23    Longnor
  24     Moreton
  25    Old Town
  26    Pontrilas & Llwydch
  27    Penyard
  28    Pontes
  29    Ross-on-Wye East
  30    Ross-on-Wye West
  31    St. Martins
  32    St. Nicholas
  33    Stoney Street
  34    Sutton Walls
  35    Three Elms
  36    Tupsley
  37    Upton
  38    Valletts
  39    Warnesley Ridge
  40    Warnesley Ridge

Herefordshire Council
Date: 25/05/2011
Status: Final
Drawing Number: Figure 5.5
GS Licence: Contains Ordnance Survey data (c) Crown copyright and database right 2011
5.4 The Impacts of Climate Change

The Evidence

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 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 change 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.

5.5 Significant Local 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. There are therefore important links between the Herefordshire SFRA and this PFRA, with additional abilities to now analyse and identify areas of local flood risk on a consistent basis across the county.

In England, Planning Policy Statement 25 (PPS25) on 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."

Adherence to Government policy ensures that new development does not increase local flood risk. Herefordshire Council has no plans to approve development that will contribute to flood risk and the SFRA was commissioned specifically to help achieve this objective, by steering future development away from flood prone areas. However, it is recognised that 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).
6. Identification of Flood Risk Areas

6.1 Indicative Flood Risk Areas

As has been explained, no indicative FRAs have been defined by applying the national guidance in Herefordshire.

6.2 New Flood Risk Areas

Herefordshire is a largely rural county with one of the lowest population densities in England. It is therefore no surprise that Herefordshire falls a long way short of the FRA threshold.

It could be argued that the national approach adopted in Wales might be more appropriate given the rural nature of the county. However, no amendments or proposed changes to the indicative Flood Risk Areas are recommended as a result of this PFRA analysis.

As a result, Annex 3 has not been required.
7. **Next Steps**

7.1 **Review**

This Preliminary Assessment Report forms a part of the PFRA process that addresses the requirements defined by the Flood Risk Regulations. These place a duty for LLFAs to assess both the impacts of past floods and the consequences of future floods. They are also required to identify whether flood risk is significant, by applying national guidance to define Flood Risk Areas. For these areas, there are further duties to prepare Flood Hazard and Risk Maps by 2013 which in turn inform the Flood Risk Management Plans that will be required by 2015.

Herefordshire Council’s Environment Scrutiny Committee was consulted during the preparation of this PFRA. They agreed that the indicative assessment of flood risk in Herefordshire was not amended and also supported the preparation of the PFRA in accordance with the Guidance provided to all Lead Local Flood Authorities by Defra. This PFRA has been developed with advice from members of the Herefordshire Flood Risk Management Partnership, as well as from members of an internal officers working group, prior to being laid before the lead Cabinet Member for final approval ahead of the EA’s deadline of 22nd June 2011.

The EA is required to review, collate and publish all PFRA submissions, in time to meet the 22nd December 2011 deadline for final submission to the European Commission. LLFAs will also publish PFRA on their websites in accordance with the requirements of the EC Inspire Directive.

While Herefordshire Council has no requirements under the Regulations to undertake Flood Hazard and Risk Mapping, or the subsequent Flood Risk Management Plans, it will review the PFRA again in 2016 as part of the 6 yearly cycle of flood risk planning.

7.2 **Local Flood Risk Management Strategy**

In preparing the PFRA, the opportunity has been taken to establish the foundations for preparing the Local Flood Risk Management Strategy for Herefordshire. This will commence later this year under duties contained in the Flood & Water Management Act 2010.

Detailed analysis of local flood risk across the county has been undertaken as part of this study and is now available to inform and communicate the issues and priorities to help prepare the future strategy. The JBA Consulting GIS software tools have allowed the completion of the PFRA and provided the means to analyse and clearly display the risk from a range of different flood sources on a Parish, Ward or entire County basis.

The PFRA process has also helped strengthen and underline the importance of partnership working between the risk management authorities and the need for sharing information through the Herefordshire Flood Risk Management Partnership. A comprehensive archive of past floods has been compiled and a database structure now exists to record the mandatory information necessary for documenting all future flood events. This will be of benefit and greatly simplify the PFRA review process due in 6 years time.

The details of critical infrastructure and properties at risk of flooding will also help inform the Herefordshire Multi-Agency Flood Plan (MFP) and assist in emergency planning and response.

The PFRA analysis will be used to inform the Local Flood Risk Management Strategy that will be developed over the next year.
Appendices

A.1 - Records of past floods and their significant consequences (Preliminary Assessment Report spreadsheet)
Records of past floods and their significant consequences

Details of the event are limited, however it is understood that fluvial discharge from the Rudhall Brook, which flows past the property called the Old Mill. This may in fact be the source of flooding.

Example:

On the 14th February 2000, there was an intense storm system that produced surface water flooding across several towns and villages throughout the county. The flooding lasted about 6 hours, and 23 residential properties were recorded as suffering internal flooding in Bishop's Castle. It is unknown whether the Old Mill was flooded due to fluvial discharge from the Rudhall Brook.

<table>
<thead>
<tr>
<th>Flood ID</th>
<th>Source</th>
<th>Date</th>
<th>Affected area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO5320538590</td>
<td>Surface and Ground water</td>
<td>14/02/2000</td>
<td>Hentland</td>
</tr>
<tr>
<td>SO5445029200</td>
<td>Ordinary watercourses</td>
<td>23/08/2006</td>
<td>Brookend Street</td>
</tr>
<tr>
<td>SO6000024004</td>
<td>Surface water</td>
<td>18/04/1998</td>
<td>Headingley</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flood ID</th>
<th>Source</th>
<th>Date</th>
<th>Affected area</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO5320538590</td>
<td>Surface and Ground water</td>
<td>14/02/2000</td>
<td>Hentland</td>
</tr>
<tr>
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<td>23/08/2006</td>
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</tr>
<tr>
<td>SO6000024004</td>
<td>Surface water</td>
<td>18/04/1998</td>
<td>Headingley</td>
</tr>
</tbody>
</table>

Note: The floods mentioned above are just a few examples of the many floods that have occurred in the past. It is important to have a comprehensive record of these events to understand the risks and take appropriate measures to prevent future flooding.
<table>
<thead>
<tr>
<th>No</th>
<th>Area flooded</th>
<th>Source of main river</th>
<th>Protective marking</th>
<th>Flood event outline</th>
<th>Date of flood</th>
<th>Comments</th>
<th>Data owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cottage flooded. The Village store in Park). Various Public House and also flooded.</td>
<td>Source of main river</td>
<td>Protective marking</td>
<td>Flood event outline</td>
<td>Date of flood</td>
<td>Comments</td>
<td>Data owner</td>
</tr>
<tr>
<td>2</td>
<td>Surface drains and rail flooded.</td>
<td>Source of main river</td>
<td>Protective marking</td>
<td>Flood event outline</td>
<td>Date of flood</td>
<td>Comments</td>
<td>Data owner</td>
</tr>
<tr>
<td>3</td>
<td>Roads and rail flooded.</td>
<td>Source of main river</td>
<td>Protective marking</td>
<td>Flood event outline</td>
<td>Date of flood</td>
<td>Comments</td>
<td>Data owner</td>
</tr>
<tr>
<td>4</td>
<td>Roads flooded.</td>
<td>Source of main river</td>
<td>Protective marking</td>
<td>Flood event outline</td>
<td>Date of flood</td>
<td>Comments</td>
<td>Data owner</td>
</tr>
<tr>
<td>5</td>
<td>Roads flooded.</td>
<td>Source of main river</td>
<td>Protective marking</td>
<td>Flood event outline</td>
<td>Date of flood</td>
<td>Comments</td>
<td>Data owner</td>
</tr>
</tbody>
</table>
A.2 - Records of future floods and their consequences (Preliminary Assessment Report spreadsheet)
Section 2.4.2: Records of future floods and their consequences

**Description of the future flood information and how it has been produced.**

**Main source:**

- Description of the future flood information and how it has been produced. Cover Regulation 1 Water Regulation, 1.

**Notes:**

- Name of locality: Herefordshire.

**Example:**

- Town records below for examples of description of assessment method. Basis: Bayes.

**Probability Refers to the Probability of the event.**

- Probability refers to the probability of the event. This sample area of 3km x 2km was modelled flooding. For more information [Flood risk management manual].

**Source of flooding:**

- Source of flooding. Refer to the main source for further information. Main source - [Environment Agency, Stourbridge].

**Consequences to human health:**

- Consequences to human health. Describe additional information not compelling - about floodwater overtopping a structure would be counted, it is important to record the method of recording. Consequences to human health.

**Consequences to non-residential infrastructure buildings:**

- Consequences to non-residential infrastructure buildings affected either by a natural flood or artificial blockage or restriction. Most UK Local Authorities are expected to produce flood risk statements. Revisit the number of critical non-residential infrastructure buildings flooded in a future event: Yes.

**Consequences to residential buildings:**

- Consequences to residential buildings affected either by a natural flood or artificial blockage or restriction. Most UK Local Authorities are expected to produce flood risk statements. Revisit the number of critical residential buildings flooded in a future event: Yes.

**Areas susceptible to flooding - case producing greatest clustering of affected: 1.

- Areas susceptible to flooding - case producing greatest clustering of affected. Kington, and other main centres of flooding also. Bromyard and Leominster, Ledbury, Wye suffering from flash flooding. Areas where modelled flooding is 0.5-1.0m deep; you must interpret this as depth of flooding, either as indication of susceptibility to flooding because of modelling uncertainties.

**Annex 2 Future Floods**

- Annexe 2 Future Floods.
### Future Floods

<table>
<thead>
<tr>
<th>Study area</th>
<th>Model date</th>
<th>Type of software used</th>
<th>Hydrology Type</th>
<th>Type of hydrology method used to create future flood information</th>
<th>Lineage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herefordshire</td>
<td>2006-03</td>
<td>2D-TuFlow</td>
<td>Commercial</td>
<td>Type of software used to create future flood information</td>
<td>Optional</td>
<td>Unmarked</td>
</tr>
<tr>
<td>Worcestershire</td>
<td>2008-04</td>
<td>2D-TuFlow</td>
<td>Commercial</td>
<td>Type of software used to create future flood information</td>
<td>Optional</td>
<td>Unmarked</td>
</tr>
</tbody>
</table>

#### Model Details

**Model Outputs**

- **Flood Extents**
  - **Greatest flood extent**
    - 153.93km²
  - **Greatest percentage**
    - 11.9km²
- **Hotspots**
  - 222 Hotspots (9.4%)
- **Environment Agency (distributed by JBA Consulting)**
  - 35 IPPC sites and 3 IPPC sites

**Model Assumptions**

- **Hydrology**
  - FEH CD-ROM, from centre of each 5km grid square.
  - Derived 6.5 hr, 1:200 chance rainfall depth; this represents a 60% confidence in the modelled flood outline from; 'High' (good confidence in the modelled flood outline) to 'Low' (poor match, about 50% confident match to past flood information).
- **Sedimentation**
  - 10% of sedimentation occurs by erosion, and 20% of sedimentation occurs by deposition.
- **River Centres**
  - 1:50k River Centreline; 1:50k valley AONB, located in Three Valleys.

**Source Data**

- **Area**
  - 10.33km² of grade 1 and 8.35km² of grade 2 land included within this.
  - 21.32km² of grade 1 land included within this.
  - 1300 Listed Buildings
  - 264.78 km² affected by road flooding, including the river and 0.66km² of agricultural land will be flooded.

**Environment Impacts**

- **Cultural Heritage**
  - 12 Listed Buildings affected by flooding with greater concentration affected in Ledbury.
  - 10.33% of cultural heritage assets located at the centre of Ledbury.

**Additional Information**

- **Data Quality**
  - 222 Hotspots (9.4%); 256.96 km² to be the worst affected.

---

**Model Details**

- **Model Outputs**
  - **Flood Extents**
    - 153.93km²
  - **Hotspots**
    - 222 Hotspots (9.4%)

---

**Source Data**

- **Area**
  - 10.33km² of grade 1 and 8.35km² of grade 2 land included within this.

**Environment Impacts**

- **Cultural Heritage**
  - 12 Listed Buildings affected by flooding with greater concentration affected in Ledbury.
  - 10.33% of cultural heritage assets located at the centre of Ledbury.

**Additional Information**

- **Data Quality**
  - 222 Hotspots (9.4%); 256.96 km² to be the worst affected.
4. Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 15% in urban areas. Manual edits applied where flow paths clearly omitted e.g. below bridges.

5. The '≥0.3m' layer shows where modelled flooding is greater than 0.3m deep.

6. Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 200 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model.

7. Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height and 70% in urban areas.

8. No allowance made for local variations in drainage, pumping or other works constructed for the purpose of flood risk management.

9. Areas that may flood are defined by dynamically routing a 1 in 200 deep rainfall event, in this case producing flooding of greater than 0.1m depth.

10. The 1 in 10 year scenario when modelled flooding is greater than 0.3m deep.

11. Risk Map for Surface Water (FMfSW) - 1 in 100 deep. Probability refers to the probability of the rainfall event in this scenario producing flooding of greater than 0.3m deep.
The document contains detailed information about the flood risk assessment in the United Kingdom, specifically focusing on the study area and its surrounding regions.

### Summary

Depth-duration-frequency curves derived from 500 Listed Buildings

#### Key Points

- **2,700 Listed Buildings**
- **3.98 km² of Detailed GIS**
- **4.14 km² of Detailed GIS**
- **158.21 km of railways**
- **6.14 km of railways**
- **1700 Listed Buildings**
- **2010-11**
- **High-Medium**
- **High-Medium**
- **18.62 km² of grade 2 agricultural land**
- **8.94 km² of grade 2 agricultural land**
- **2.88 km² of grade 1 and 2 agricultural land**
- **69.86 km of railways**
- **10.33 km of railways**
- **Malvern Hills AONB**
- **Valley AONB**
- **Lugg**
- **Concentration in the Environment Agency**
- **Pollution**
- **Pollution**
- **Runoff sites**
- **IPPC sites**
- **21 ancient sites**
- **28 ancient sites**
- **Ross-Leight Ward**
- **Bromyard**
- **Bromyard**
- **Wye Valley**
- **Lower Wye**
- **Hereford**
- **Ledbury**
- **Kington**
- **Village of Ledbury**
- **Malvern Hills AONB**
- **Science Facts**
- **Science Facts**
- **Science Facts**
- **Science Facts**
- **Science Facts**

#### Additional Information

- **Topography (DTM, OSMM)**
- **Rainfall Hyetograph, EA 2m Composite**
- **Unmarked**

---

### Annex 2 Future Floods

**Depth-duration-frequency curves derived from 3D and 4D Rainfall Data**

- **Pollution**: Pollutants observed in the Environment Agency.
- **Waste Licence sites**: Disposal points identified by the Environment Agency.
- **IPPC sites and 21 ancient sites**: Historical sites recognized by the Environment Agency.

**Flood Risk Mapping**

- **Risk Assessment**
- **133 Hotspots (5.6% or 0.34 km²)**
- **133 Hotspots (5.6% or 0.34 km²)**

**Assessment Method**

- **Derive 1.1 hr, 1:200 chance rainfall depth**
- **Derive 1.1 hr, 1:300 chance rainfall depth**
- **Derive 1.1 hr, 1:900 chance rainfall depth**

**FEH CD-ROM**

- **Topography (DTM, OSMM)**
- **Rainfall Hyetograph, EA 2m Composite**
- **Unmarked**

The document provides a comprehensive analysis of flood risk and mitigation strategies, including detailed GIS data, historical records, and future projections.
### Annex 2: Future Floods

<table>
<thead>
<tr>
<th>Site</th>
<th>County</th>
<th>Province</th>
<th>Reference</th>
<th>Background</th>
<th>Groundwater</th>
<th>High</th>
<th>Natural reoccurrence</th>
<th>Natural flood</th>
<th>Is it suitable for development?</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 5000 square grid.</td>
<td>Herefordshire</td>
<td>B3071/028/030</td>
<td>Various villages and towns located throughout Herefordshire. The area of interest includes the River Wye, River Lugg, and River Weir, and is susceptible to flooding through groundwater and surface water.</td>
<td>Groundwater</td>
<td>High</td>
<td>Natural reoccurrence</td>
<td>Natural flood</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Modelling developed from combination of national (2004) and local (generally 1998-2010) flood risk models.</td>
<td>Herefordshire</td>
<td>B3071/028/030</td>
<td>Various villages and towns located throughout Herefordshire. The area of interest includes the River Wye, River Lugg, and River Weir, and is susceptible to flooding through groundwater and surface water.</td>
<td>Groundwater</td>
<td>High</td>
<td>Natural reoccurrence</td>
<td>Natural flood</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
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<td>B3071/028/030</td>
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<td>High</td>
<td>Natural reoccurrence</td>
<td>Natural flood</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- **AStGWF** is a strategic scale map showing groundwater flood areas on a 5000 square grid.
- This data has been generated by the Hydrogeology Group, which was developed on a 5000 square grid resolution.
- The map is published by the Environment Agency and shows areas of groundwater susceptibility.
- The map is the result of a combination of national and local data, with local data being particularly important.
- **Natural flood** modelling used Manning’s n of 0.1 for national fluvial modelling, variable (calibrated) values for national catchment through the model to ascertain water level and thus depth and extent.
- **Topography** derived from LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m), NEXTMap 5m grid DTM, and NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & infrastructure.
- **Surface water** extent of defences, refer to National Flood Risk Assessment (NaFRA) data. Marked "Protect" for complete national flood zone 1 and "Caution" for complete national flood zone 2. Flood Map for river only. Flood Map for river and sea. Flood zone 3 is unknown. Extreme flood outline is flood zone 2 extending inland for flood. Topography is important for flood risk management. Modelled extent that there are no inland defences.
- For the purpose of flood risk management, models assume that there are no raised defences.
The Environment Agency has developed flood risk maps using data from published sources such as the National Flood Estimation Handbook (FEH), the historic flooding database, and other national datasets. These maps are used to identify areas at risk of flooding and to determine the likelihood of future flooding, taking account of changes in land use and climate. The flood risk assessment process involves the use of RAS, TUFLOW, and JFLOW models, which generate flood risk estimates for different flood scenarios, such as 1 in 100 chance flood events or 1 in 200 chance flood events. The flood risk maps are updated quarterly, and the most recent version was released in 2019. The flood risk maps are available to the public and can be accessed via the Environment Agency’s website.

The flood risk maps are used to identify areas that are at risk of flooding and to determine the likelihood of future flooding. The flood risk assessment process involves the use of RAS, TUFLOW, and JFLOW models, which generate flood risk estimates for different flood scenarios, such as 1 in 100 chance flood events or 1 in 200 chance flood events. The flood risk maps are updated quarterly, and the most recent version was released in 2019. The flood risk maps are available to the public and can be accessed via the Environment Agency’s website.
A.3 - Records of Flood Risk Areas and their rationale (Preliminary Assessment Report spreadsheet)

N/A
A.4 - PFRA Review Checklist
<table>
<thead>
<tr>
<th>Checklist questions</th>
<th>Notes for completion</th>
<th>LLFA</th>
<th>Environment Agency area review</th>
<th>Environment Agency national review</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1 Set up governance and develop partnerships</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Have appropriate governance and partnership arrangements been set up?</td>
<td>Refer to section 2.3 of guidance. Governance and partnership arrangements should be to the satisfaction of the LLFA.</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.2 Who in the LLFA reviewed the PFRA and when was it done?</td>
<td>Please state the review and approval process and when approval was gained e.g. Officer, Scrutiny Committee, Cabinet. Refer to Section 5 of the guidance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2 Determine appropriate data systems</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Has a data management system been established and implemented?</td>
<td>See Annex 5 for information about data standards</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3 Collate information on past and future floods and their consequences</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Has information been requested from all relevant partners?</td>
<td>See Flood Risk Regulations Part 6 Co-operation.</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 Are there any gaps in available information? (This could include gaps which could have been filled but weren’t, or gaps which couldn’t be filled because the information wasn’t available)</td>
<td>LLFAs - Are there gaps in certain locations, or for certain events that you are aware of, or for certain sources of flooding (such as groundwater). Respond with Yes/No and provide comments on any missing information. EA Review - Has all available information been gathered and included?</td>
<td>Yes - some past flood records are incomplete and unreliable and have therefore been excluded</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4 Determining locally agreed surface water information</strong></td>
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</tr>
<tr>
<td>4.1 Which dataset (or combination of datasets) has been determined as &quot;locally agreed surface water information&quot;?</td>
<td>LLFAs - Select from drop down. Refer to &quot;Locally agreed surface water information&quot; text box in section 3.5.1 (p.17) of guidance. EA review - Has this been agreed?</td>
<td></td>
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</tr>
<tr>
<td>4.2 Has the locally agreed surface water information been clearly stated and presented (on a map) in the Preliminary Assessment Report?</td>
<td>LLFAs - Select Yes/No from drop down list. Refer to &quot;locally agreed surface water information&quot; text box in section 3.5.1 (p.17) of guidance.</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.3 If available, what is the total property count for locally agreed surface water information in the LLFA?</td>
<td>If known, please enter the total number of properties at risk in the LLFA.</td>
<td>9500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.4 If applicable, has the method for counting properties been described in the Preliminary Assessment Report?</td>
<td>Refer to text box on page 17 of guidance</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.5 Has available information on local drainage capacity (where used to inform the determination of locally agreed surface water information) been included in the report?</td>
<td>Refer to text box on page 17 of guidance. Information provided on drainage may inform options for any future improvements to the Flood Map for Surface Water.</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 5</td>
<td>Checklist questions</td>
<td>Notes for completion</td>
<td>LLFA</td>
<td>Environment Agency area review</td>
</tr>
<tr>
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</tr>
<tr>
<td>5.1</td>
<td>Does the Preliminary Assessment Report cover all the content described in Annex 1 of the Environment Agency's PFRA guidance?</td>
<td>LLFAs - If the Preliminary Assessment Report contains all the content described in Annex 2 of the PFRA guidance, respond with a &quot;Yes&quot;. If there are some elements missing, please provide a brief explanation. EA Review - Include comments on any missing content.</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Has a summary table of flood events been produced?</td>
<td>Refer to section 3.4 and 3.5 of guidance</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>Has a description of past flood events been included?</td>
<td>Refer to section 3.4 and 3.5 of guidance</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>5.4</td>
<td>Has additional information been included on climate change and long term developments?</td>
<td>Refer to 3.6 of guidance. Standard text has been provided for Preliminary Assessment Reports which meets the minimum requirements of the Flood Risk Regulations. Please respond with Yes or No, and if additional information has been included, please state the information source(s)</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 6</th>
<th>Record information on past and future floods with significant consequences in spreadsheet</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Are records of past flooding with significant harmful consequences recorded on the Preliminary Assessment Report spreadsheet (Annex 1 of Preliminary Assessment Report)?</td>
<td>LLFAs - past flooding should be recorded on the spreadsheet and included as Annex 1 of the Preliminary Assessment Report. EA review - Are all the mandatory fields complete?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2</td>
<td>Are there any past floods with significant harmful consequences that have not been recorded? If so, please explain why not.</td>
<td>LLFAs - Respond with Yes or No. If No, provide additional information e.g. anecdotal information on flood, but not enough evidence to include EA review - Do you agree with LLFA response and comments?</td>
<td>Yes - some incomplete and unattributed records have been excluded due to uncertainty</td>
<td></td>
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</tr>
<tr>
<td>6.3</td>
<td>Have any additional records of future flooding (other than the national dataset information which is already completed) been recorded on the future flooding Preliminary Assessment Report spreadsheet (Annex 2 of Preliminary Assessment Report)?</td>
<td>LLFAs - future flooding information should be recorded on the spreadsheet and included as Annex 2 of the Preliminary Assessment Report. EA review - Are all mandatory fields complete?</td>
<td>Yes</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 7</th>
<th>Illustrate information on past and future floods</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Have summary maps been produced for past and future floods?</td>
<td>Refer to section 3.4 and 3.5 of guidance</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 8</th>
<th>Review indicative Flood Risk Areas</th>
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</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
<td>Is your LLFA within an indicative Flood Risk Area?</td>
<td>Indicative Flood Risk Areas were provided to LLFAs by the Environment Agency in December 2010.</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.2</td>
<td>If the answer to 8.1 is yes, have you reviewed it using the locally agreed surface water information, and relevant local information in the Preliminary Assessment Report?</td>
<td>Note to section 4 of guidance. LLFAs should identify whether they have reviewed against local information or just used the indicative Flood Risk Area information provided by the Environment Agency.</td>
<td>NA</td>
<td></td>
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</tr>
</tbody>
</table>
### Preliminary Flood Risk Assessment Checklist

**LLFA Name:**

**Herefordshire Council**

<table>
<thead>
<tr>
<th>Step 9</th>
<th>Checklist questions</th>
<th>Notes for completion</th>
<th>LLFA</th>
<th>Environment Agency area review</th>
<th>Environment Agency national review</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1</td>
<td>Is a Flood Risk Area proposed?</td>
<td>LLFA - select a response from the drop down list and then complete the relevant questions 9.1.1 - 9.1.5. (NB. Indicative Flood Risk Areas can be amended due to Geography, past flooding and/or future flooding.)</td>
<td>No - no Flood Risk Area is proposed (go to question 9.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.1.1</td>
<td>If the proposed Flood Risk Area is exactly the same as the indicative Flood Risk Area, please confirm.</td>
<td>LLFA - please confirm that the boundary of the indicative Flood Risk Area has not been changed and no change has been made to the flood risk indicators. EA review - please confirm</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.1.2</td>
<td>If changes have been made to the indicative Flood Risk Area because of geography, please identify what changes have been made.</td>
<td>Use the drop down list to identify the reasons for the change. Options are the same as the table on page 26 of the PFRA guidance. EA review - please confirm evidence supports change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.1.3</td>
<td>If changes have been made to the indicative Flood Risk Area because of past/historic flooding, please indicate the changes and the reasons why.</td>
<td>LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. records of historic flooding. EA review - confirm scale of the changes made and provide indication of confidence in the evidence provided e.g. anecdotal evidence versus detailed report on flooding event.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.1.4</td>
<td>If changes have been made to the indicative Flood Risk Areas because of future flooding, please indicate the changes and the reasons why.</td>
<td>LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. detailed modelling as part of SWMP. EA review - confirm scale of the changes made and indication of confidence in the evidence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.1.5</td>
<td>If a new Flood Risk Area is being proposed, does it meet the Defra/WAG thresholds?</td>
<td>Criteria and thresholds are set out in the Defra/WAG guidance on selecting and reviewing Flood Risk Areas for local sources of flooding. EA review - identify the evidence provided to support this and indicate degree of confidence in the evidence.</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.2</td>
<td>Does the proposed Flood Risk Area include flooding from interactions with main river, reservoirs or the sea?</td>
<td>LLFAs should respond with Yes or No. EA Review - Summarise the location and nature of interactions i.e. river or sea.</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3</td>
<td>Has an indicative Flood Risk Area been deleted?</td>
<td>LLFA - Respond with Yes/No and if an indicative Flood Risk Area has been deleted please provide a short description why. EA - confirm the evidence presented to support this is aligned to locally agreed surface water information.</td>
<td>No</td>
<td></td>
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</tr>
</tbody>
</table>

### Step 10 Record information including rationale - ONLY COMPLETE IF ANSWER TO 9.1 IS YES

| 10.1 | If proposing Flood Risk Areas, have the mandatory fields in the spreadsheet been completed? | LLFAs - the spreadsheet indicates mandatory columns to be completed. EA Review - Are all mandatory fields complete? | N/A |  |  |
| 10.2 | Has a rationale and evidence for amending/adding/deleting Flood Risk Areas been included in the Preliminary Assessment Report? | LLFAs - Refer to Table 5 on page 26 of the PFRA guidance and Annexes A-D of the Defra/WAG Guidance. Rationale should be included in "Identification of Flood Risk Areas" section of Preliminary Assessment Report. EA Review - Confirm that supporting evidence for any amendments/additions/deletions has been provided in the Preliminary Assessment Report and annexes | N/A |  |  |
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Edinburgh
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Limerick
Newcastle upon Tyne
Newport
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Saltaire
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