

**City of Bradford MDC**

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**City of Bradford Metropolitan District  
Council  
Preliminary Flood Risk Assessment  
to comply with the Environment Agency  
Final Guidance**



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## Abbreviations

Term	Definition
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
AMP	Asset Management Plan
Asset Management Plan	A plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.
AStSWF	Areas Susceptible to Surface Water Flooding
BD	Bradford District
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances including flooding.
CLG	Government Department for Communities and Local Government
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Critical Drainage Area	Areas of significant flood risk, characterised by the amount of surface runoff that drains into the area, the topography and hydraulic conditions of the pathway (e.g. sewer, river system), and the receptors (people, properties and infrastructure) that may be affected.
Culvert	A channel or pipe that carries water below the level of the ground.
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DG5	Register A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
DTM	Digital Terrain Model
EA	Environment Agency
FAS	Flood Alleviation Scheme
FCERM	Flood and Coastal Erosion Risk Management (FCERM)
Indicative Flood Risk	Areas determined by the Environment Agency as indicatively having Areas 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.
FMfSW	Flood Map for Surface Water
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.

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<b>Term</b>	<b>Definition</b>
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRR	Flood Risk Regulations
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
LDF	Local Development Framework
Lead Local Flood Authority	Local Authority responsible for taking the lead on local flood risk management
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
Local Resilience	A multi-agency forum, bringing together all the organisations that Forum have a duty to cooperate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a coordinated manner.
LPA	Local Planning Authority
LRF	Local Resilience Forum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NRD	National Receptor Dataset – a collection of risk receptors produced by the Environment Agency
Ordinary Watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, IDBs
PAR	Preliminary Assessment Report
Partner	A person or organisation with responsibility for the decision or actions that need to be taken.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial Flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow.
PPS25	Planning and Policy Statement 25: Development and Flood Risk
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority	As defined by the Floods and Water Management Act
RMA	Risk Management Authority
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.

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<b>Term</b>	<b>Definition</b>
SUDS	Sustainable Drainage Systems
Sustainable Drainage	Methods of management practices and control structures that are Systems designed to drain surface water in a more sustainable manner than some conventional techniques.
Surface water	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.
SWMP	Surface Water Management Plan
WAG	Welsh Assembly Government
WaSC	Water and Sewerage Company

## Executive Summary

This Preliminary Assessment Report (PAR) is a key document informing the preparation of future Local Flood Risk Management Strategies as required by the Flood Risk Regulations 2009 & the Flood and Water Management Act 2010 (FWMA)<sup>1</sup>. This PAR identifies key flood risk areas within Bradford District (BD). This document fulfils the City of Bradford Metropolitan District Councils (CBMDC) obligations as a Lead Local Flood Authority (LLFA) under the requirements of the Flood Risk Regulations 2009 (FRR)<sup>2</sup>

The Flood Risk Regulations require the Environment Agency to assess the Risk from Main River Sources.

The PAR along with the supporting figures fulfil the first stage Preliminary Flood Risk Assessment (PFRA) requirements of the Regulations. The PFRA is a high level screening exercise that brings together readily available information from a number of sources to assess local flood risk. As LLFA, CBMDC are required to submit their PFRA to the Environment Agency by the 22nd June 2011.

The Department for Environment, Food and Rural Affairs (DEFRA) and the Welsh Assembly Government (WAG) have established a series of significance and threshold criteria to define flood risk areas in England and Wales. Guidance on applying these thresholds has been provided by DEFRA<sup>3</sup>. The Environment Agency used the DEFRA criteria to develop a national dataset which identified Indicative Flood Risk Areas, in this report these outputs are compared to locally produced maps and data.

For the PFRA all readily available data was collated from key stakeholders within BD. This allowed for the identification of significant historic flood events within the District. There were several limitations associated with the stakeholder data. The main issues related to inconsistent and incomplete

methods of recording. These issues resulted in a limited methodology for the knowledge of flooding sources and the consequences of events. From the information collated only the event in Ilkley on 12 July 1900 is considered to be significant (excluding Main River events)

Future flood risk within BD has been assessed by looking at the District as a whole and assessing potential risk areas based on a variety of local flooding sources. The Environment Agency's Areas Susceptible to Surface Water Flooding (ASStSWF), Flood Map for Surface Water (FMfSW), Fluvial Flood Zones and the British Geological Society's Groundwater Susceptibility Maps were used to identify areas at risk. There is a mix of low/medium/high risk of flooding from multiple sources across the BD, with the highest number of properties at risk from main rivers and broader catchment causes. Based on the FMfSW approximately 7250 properties are at risk of flooding to a depth more than 0.3 metres in a 1 in 200 year rainfall event (of these properties at risk, approximately 80% are residential properties).

NOTE: Figures from the "Inquiry to Consider the Future of Water Management and the Associated problems of Flooding in the Bradford District, 2004" (Ashley et al), are summarised as Main rivers and broader catchment causes, Number of people at risk – 13,500, and intra-urban watercourses, local flooding and sewerage 1 in 10yr 2,000, this report was based on the Foresight Future Flooding Report which was based on cost rather than risk and are therefore not directly comparable to more recent nationally derived mapping.

**Under the criteria set by Defra there are no areas which can be considered as being at 'significant risk'**

# 1 Introduction

## 1.1 Preliminary Flood Risk Assessment

This document reports the findings of research undertaken by the Drainage Services Unit for City of Bradford MDC towards the preparation of a Preliminary Flood Risk Assessment (PFRA) for their administrative area. The report is based on readily available information from key stakeholders, Council records and work carried out as part of the EU Interreg IVB Flood Resilient City Project.

The chief drivers behind this research and preparation of the PFRA report are two sets of new legislation: the Flood Risk Regulations (FRR: The Regulations), which came into force on the 10th December 2009, and the Flood & Water Management Act (FWMA) which gained Royal Assent on the 8th April 2010. Under these pieces of legislation, all Unitary Authorities are designated a Local Lead Flood Authority (LLFA) and have formally been allocated a number of key responsibilities with respect to local flood risk management. A full description of these responsibilities is provided in Chapter 2.

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

- Preliminary Flood Risk Assessments;
- Flood hazard and flood risk maps;
- Flood Risk Management Plans.

An excerpt from the Flood Risk Regulations 2009 regarding the duty to prepare PFRAs is shown in Figure 1-1; the section highlighted in red shows the responsibilities of LLFAs to produce PFRAs.

**Figure 1-1: Excerpt from Flood Risk Regulations 2009 relating to the production of PFRAs**

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<p>PART 2 PRELIMINARY FLOOD RISK ASSESSMENTS</p>	
<p><b>Duty to prepare preliminary assessment maps and reports: Environment Agency</b></p>	
<p>9.—(1) The Environment Agency must prepare in relation to each river basin district—</p>	
<p>(a) a preliminary assessment map, and</p>	
<p>(b) a preliminary assessment report in relation to flooding from—</p>	
<p>(i) the sea,</p>	
<p>(ii) main rivers, and</p>	
<p>(iii) reservoirs.</p>	
<p>(2) This regulation is subject to regulations 31 and 32.</p>	
<p><b>Duty to prepare preliminary assessment reports: lead local flood authorities</b></p>	
<p>10.—(1) A lead local flood authority must prepare a preliminary assessment report in relation to flooding in its area.</p>	
<p>(2) A lead local authority is not required to include in its report information about flooding from a source mentioned in regulation 9(1)(b) unless the authority thinks that it may affect flooding from another source.</p>	
<p>(3) The Environment Agency—</p>	
<p>(a) must review a preliminary assessment report prepared under this regulation, and</p>	
<p>(b) may recommend modifications.</p>	
<p>(4) Following a review, a lead local flood authority may revise its preliminary assessment report.</p>	
<p>(5) The Agency’s power to require information under regulation 36 includes power to require a lead local flood authority to provide a preliminary assessment report by a specified date.</p>	
<p>(6) This regulation is subject to regulations 33 and 34.</p>	

Table 1-1 shows the elements of work required from City of Bradford MDC under the Flood Risk Regulations 2009, along with the timescales of their respective delivery. The first two elements of work, highlighted in black, are covered by the preparation of this PFRA report.

**Table 1-1: Elements of Work required under the Flood Risk Regulations 2009**

22 <sup>nd</sup> June 2011	<b>Prepare Preliminary Assessment Report.</b>	<i>The PFRA should focus on local flood risk from surface water, groundwater, ordinary watercourses and canals.</i>
22 <sup>nd</sup> June 2011	<b>On the basis of the PFRA, identify Flood Risk Areas.</b>	<i>Flood Risk Areas are areas of significant risk identified on the basis of the findings of the PFRA, national criteria set by the UK Government Secretary of State and guidance provided by the Environment Agency.</i>
22 <sup>nd</sup> June 2013	Prepare <b>Flood Hazard Maps</b> and <b>Flood Risk Maps</b> for each Flood Risk Area.	<i>Used to identify the level of hazard and risk of flooding within each Flood Risk Area to inform Flood Risk Management Plans.</i>
22 <sup>nd</sup> June 2015	Prepare <b>Flood Risk Management Plans</b> for each Flood Risk Area.	<i>Plans setting out risk management objectives and strategies for each Flood Risk Area.</i>

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

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



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It is also noted that the PFRA report must consider floods which have significant harmful consequences for human health, economic activity and the environment.

As described in Figure 1-1, flooding associated with the sea, main rivers and reservoirs is the responsibility of the Environment Agency and does **not** need to be considered by the LLFA as part of the PFRA, unless it is considered that it may affect flooding from one of the sources listed above.

## 1.2 Study Area

The study area for this PFRA is defined by the administrative boundary of City of Bradford MDC. Bradford is a major metropolitan authority (fourth largest district in England) covering an area of approximately 370 km<sup>2</sup>. Around one third of the district is built up and the population is estimated at 501,700 (ONS 2008 mid year estimate). The main urban area of the district is comprised of the City of Bradford. Along the Aire Valley (Airedale) to the North of Bradford City are Shipley and the freestanding towns of Keighley, Bingley and Silsden and the smaller settlement of Steeton with Eastburn. 77% of the population live within Bradford and Airedale. To the North of Airedale, within Wharfedale, is the freestanding town of Ilkley and the smaller settlements of Menston and Burley in Wharfedale, as well as the village of Addingham. The rural areas include many other settlements; larger villages such as Wilsden and Oakworth and smaller settlements like Harden. The geographical extent of the study area is illustrated in Figure 1.2.

**Figure 1.2. Bradford Metropolitan District Council Administrative Area.**



The study area includes the catchment areas of the River Aire and the River Wharfe, the latter forming a main river within the River Ouse catchment. The study area is served by Yorkshire Water and the North East region of the Environment Agency. Bradford district is bounded to the East by Leeds City Council (unitary authority), the North by the Yorkshire Dales National Park and North

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Yorkshire County Council (multi tier authority). Kirklees Council lies to the South, Calderdale Council to the West (all unitary authorities) and Craven District Council (lower tier authority) is to the North West.

The study area also includes part of the Airedale Internal Drainage Board (IDB) above Keighley

## 1.3 Aims and Objectives

The PFRA is a high level screening exercise to locate areas in which the risk of surface water and groundwater flooding is significant and warrants further examination through the production of maps and management plans.

The aim of this PFRA is to provide an assessment of local flood risk across the study area, including information on past floods and the potential consequences of future floods.

The key objectives can be summarised as follows:

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

## 2 LLFA Responsibilities

### 2.1 Introduction

The preparation of a PFRA is just one of several responsibilities of LLFAs under the new legislation. This section provides a brief overview of other responsibilities City of Bradford MDC are obliged to fulfil under their role as a LLFA.

### 2.2 Coordination of Flood Risk Management

In his Review of the summer 2007 flooding, Sir Michael Pitt stated that *“the role of local authorities should be enhanced so that they take on responsibility for leading the coordination of flood risk management in their areas”*. As the designated LLFA, City of Bradford MDC is therefore responsible for leading local flood risk management across Bradford District.

Much of the local knowledge and technical expertise necessary for City of Bradford MDC to fulfil their duties as LLFA lies with the District councils and other partner organisations. It is therefore crucial that City of Bradford MDC work alongside these groups and organisations as they undertake their responsibilities to ensure effective and consistent management of local flood risk throughout the county and to contribute to the provision of a coordinated and holistic approach to flood risk management across the study area.

As Lead Local Flood Authority, it is the role of City of Bradford MDC to forge effective partnerships with Yorkshire Water, the Environment Agency and Internal Drainage Boards (IDBs) as well as other key stakeholders and risk management authorities. Ideally these working arrangements should be formalised to ensure clear lines of communication, mutual co-operation and management through the provision of Level of Service Agreements (LoSA) or Memorandums of Understanding (MoU).

In order to assist with this, City of Bradford MDC has identified a number of panels, steering groups, partnerships and working groups across the different organisations and set up a Member-led Partnership for Flood Management to provide an overarching lead. It has also opened up its internal steering group to act as an officer-led operational group in conjunction with representatives from the Environment Agency and Yorkshire Water.

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As the designated LLFA, Bradford Council is responsible for leading local flood risk management across the district. Much of the local knowledge and technical expertise necessary for the LLFA to fulfil their duties lies with partner organisations. It is therefore crucial that Bradford Council works alongside these partner organisations to ensure effective and consistent management of local flood risk throughout the borough, which contributes to the provision of a coordinated and holistic approach to flood risk management across the District.

As the LLFA, Bradford Council is responsible for forging effective partnerships with Yorkshire Water and the Environment Agency, as well as other key stakeholders and risk management authorities.

Ideally the working arrangements with external stakeholders should be formalised to ensure clear lines of communication, mutual co-operation and management through the provision of Level of Service Agreements (LoSA) or Memorandums of Understanding (MoU). These matters will be addressed in future.

## 2.3 Stakeholder Engagement

As part of the PFRA, Bradford council sought to engage stakeholders representing the following organisations and authorities.

British Waterways  
Environment Agency  
Highways Agency  
Network Rail  
West Yorkshire Fire Service  
West Yorkshire Police  
Yorkshire Water  
Airedale IDB

It is important to note that we have communicated with and collated data from various sector/department leads within the Local Authority, including Emergency Planning, Highways, and Environmental Health.

## 2.4 Public Engagement

It is important to incorporate public engagement into local flood risk management planning. The public can provide invaluable information which can aid the development of more effective management strategies. By keeping the public informed of future flood risk management plans trust can be built between the public and the local government.

Subsequent stages of this process, will require increasing levels of public engagement, particularly during the formulation of the local flood risk management plans (for the Flood Risk Areas within Bradford District) as this will help to inform future levels of public engagement. It is recommended that Bradford Council follow the guidelines outlined in the Environment Agency's 'Building Trust with Communities' document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums. Public consultation is also an essential part of the EU Interreg IVB Flood Resilient City Project and experience gained from previous Interreg Projects NORIS and Urban Water Cycle will also be drawn on.

## 2.5 Further Responsibilities

Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for LLFA from the FWMA and FRR.

These responsibilities include:

Responsibility	Details
Asset Register	LLFAs have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
Designation powers	LLFAs, as well as the Environment Agency have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.
Investigating flood incidents	LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out. Further information with respect to this duty is provided in Chapter 7.
Local Strategy for Flood Risk Management	LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments
SUDS Approval Body	LLFAs are designated the SUDS Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new sustainable drainage systems (SUDS) within their area
Works powers	LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area

**Table 2.1. LLFA Responsibilities under the FRR and FWMA (Beige boxes indicate duties that have yet to be commenced into UK law at time of writing)**

## 3 Methodology and Data Review

### 3.1 Introduction

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

The approach for producing this PFRA was based upon the Environment Agency's PFRA Final Guidance, which was released in December 2010. The PFRA is based on readily available or derivable data.

### 3.2 Methodology

#### Data Collection from Partner Organisations

The following authorities and organisations were identified and contacted to share data for the preparation of the PFRA; Environment Agency, West Yorkshire Police, West Yorkshire Fire Service and Yorkshire Water. Within the Council the Drainage Services Unit, Council Contact, Emergency Planning, Highways and Environmental Health were sent information requests.

Figure 3.1 provides an example of the pro forma spreadsheets City of Bradford MDC used and distributed, to assist in the collection of anecdotal information on known flooding hotspots.

#### Figure 3.1: Example Spreadsheet completed for Data Collection

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Property name/ number/address/Town	Full Postcode	Approx extent of flooding	Depth of flooding (m)	Frequency of flooding	Flooding source	Residential properties flooded (if yes (number))	Commercial properties flooded (if yes (number))	Damage caused
1 Back Field	BD13 3EX	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
1 Cark Road	BD21 3BT	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
1 Carrington Street	BD3 8AE	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
1 Clement Street	BD8 9SH	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
1 Diamond Street	BD22 7DL	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
1 Hazelwood Avenue	BD20 5EE	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
1 Tillotson Street	BD20 9LJ	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
10 Acres Street	BD21 1JA	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor
10 Feamsides Terrace	BD6 8PW	Cellar water - sub floor area	Not known	Not known	Groundwater	Yes (1)	No	Minor

Assessing Historic Flood Risk

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

It was anticipated that information could be provided in a geo-referenced format. However, where this was not the case, where addresses were provided these have since been geo-referenced. This made it possible to display this information using GIS software and overlay layers to identify the spatial distribution of historic flood events and relate these datasets to receptor information, in order to assess the overall flood risk.

Assessing Future Flood Risk

The identification of Flood Risk Areas through the PFRA should also take into account future floods, defined as any flood that could potentially occur in the future. This definition includes predicted floods extrapolated from current conditions in addition to those with an allowance for climate change. The assessment of future flood risk will primarily rely on a technical review of the Environment Agency's Flood Map for Surface Water which has been recently circulated to Lead Local Flood Authorities. The Flood Map for Surface Water uses a numerical hydraulic model to predict the extent of flood risk from two rainfall events (1 in 30 year return period and 1 in 200 year return period).

The following factors were considered when assessing *future* flood risk across the BD; topography, location of ordinary watercourses, location of flood plains that retain water, characteristics of watercourses (lengths, modifications), effectiveness of any works constructed for the purpose of flood risk management, location of populated areas, areas in which economic activity is concentrated, the current and predicted impact of climate change and the predicted impact of any long-term developments that might affect the occurrence or significance of flooding, such as proposals for future development.

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**Identifying Flood Risk Areas**

Information regarding historic and future flood risk will be used to formally identify Flood Risk Areas. To achieve this, *flood risk indicators* will be used to determine the impacts of flooding on human health, economic activity, cultural heritage and the environment. The use of flood risk indicators helps to develop understanding of the impacts and consequences of flooding. Key flood risk indicators are summarised in Table 3.1.

**Table 3.1. Key Flood Risk Indicators**

Impacts of flooding on:	Flood Risk Indicators
Human Health	Number of residential properties. Critical services (Hospitals, Police/Fire/Ambulance Stations, Schools, Nursing Homes, etc).
Economic Activity	Number of non-residential properties. Length of road or rail. Area of agricultural land.
Cultural Heritage	Cultural heritage sites (World Heritage Sites).
Environment	Designated sites (SSSIs, SACs, SPAs, etc) and BAP habitat.

The above indicators have been selected and analysed by Defra and the Environment Agency using the Flood Map for Surface Water mapping and the National Receptors Database in order to identify areas where flood risk and potential consequences exceed a pre-determined threshold described in Table 3-2

**Table 3.2 Flood Risk Threshold Used to Identify Future Consequences of Flooding**

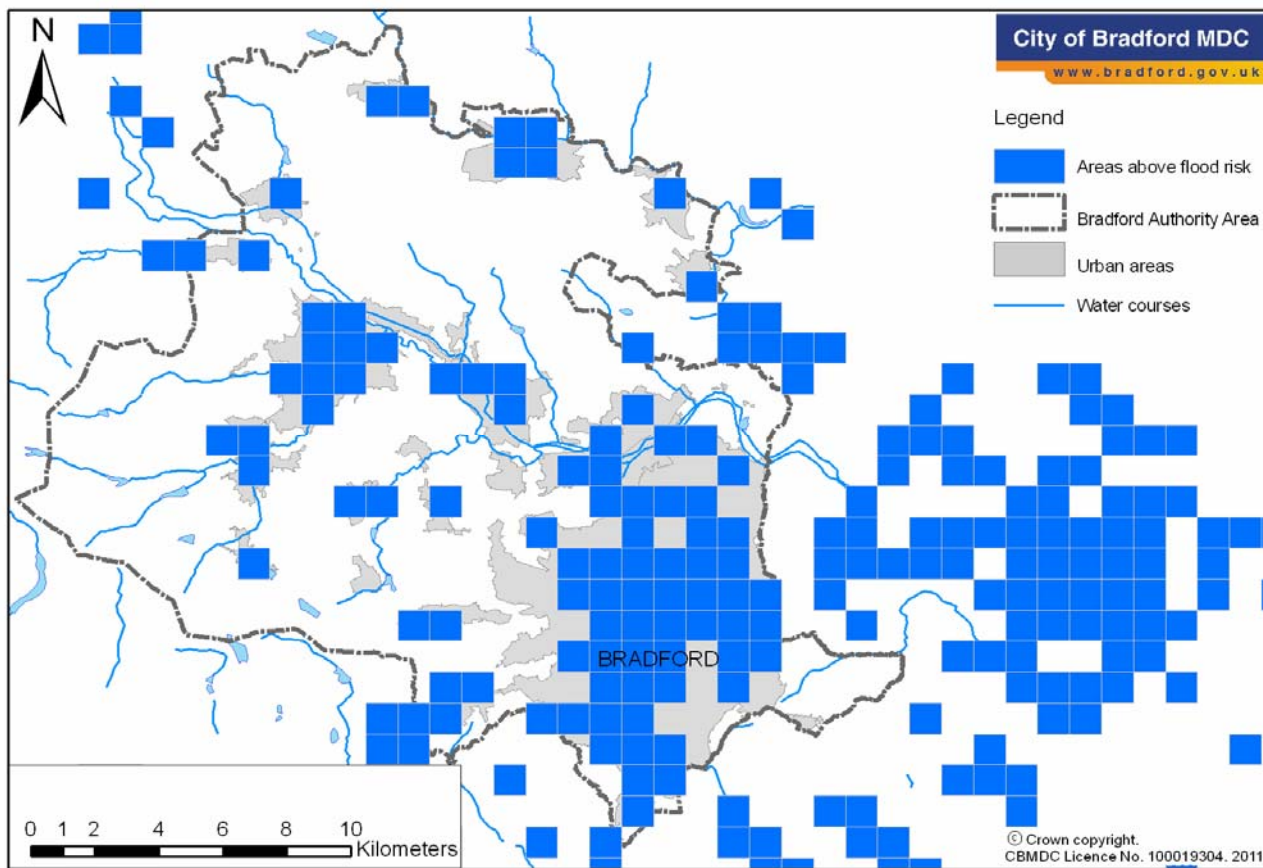
'Significant harmful consequences' defined as greater than...	Description
200 people <i>or</i>	<i>Flooded to a depth of 0.3m during a rainfall event with a 1 in 200 chance of occurring (or 0.5%)</i>
20 businesses <i>or</i>	
1 critical service	

This assessment was carried out based on 1km<sup>2</sup> national grid squares, and the grid squares that exceed these criteria in the Bradford area were identified as shown in Figure 3-2

**Figure 3.2 Areas Above Environment Agency Flood Risk Threshold.**



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The areas that have been identified using this methodology *and* exceed 30,000 people at risk have been mapped and identified as Indicative Flood Risk Areas: the Bradford District was not identified as having an Indicative Flood Risk Area. For further details, please refer to Defra’s Guidance for selecting and reviewing Flood Risk Areas for local sources of flooding (December 2010).

### 3.3 Data Sources

See 3.2

### 3.4 Data Limitations

There are a number of limitations with the data provided for this PFRA. The intention of the report is to collect readily available data and this data has been used as provided. It is recommended that the issues identified below will act as a reminder to those involved in local Flood Risk Management to improve the calibre of flood risk information going forward. A number of issues that are common within the Bradford District are summarised below:

**Inconsistent Recording Systems**

The lack of a consistent flood data recording system across departments within CBMDC has led to major inconsistencies in the recording of flood event data. This has resulted in incomplete, or sometimes nonexistent, flood record datasets. Further information on addressing this issue in the future is included in Chapter 7.

**Incomplete Datasets**

As a result of the lack of consistent flood data recording arrangements (as described above), many departments have poor flood records. Some of the datasets collated are not exhaustive and it is felt

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that they are unlikely to accurately represent the complete flood risk issues in a particular area. The corresponding gaps in flood data will hinder also the identification of accurate flood risk areas.

**Varied Quality of Data**

Based upon the data collected from all sources described above, there was found to be varied quality in historic flood records and information. For example, datasets from some organisations provided details of historic flood events with precise geo-referenced locations, whereas others provided brief computer records of flooded locations.

**Records of Consequences of Flooding**

Very few data providers were able to provide comprehensive details of the consequences of specific past flood events, which made accurately assessing the consequences of historic flooding difficult.

### 3.5 Quality Assurance, Security and Data Restrictions

Flood historical data was assessed for its data quality and suitability for use in the Assessment of Significant Risk as per the Environment Agency's PFRA Guidance. Further quality checks will be undertaken as part of the SWMP in accordance with DEFRA guidance<sup>10</sup>.

A majority of the data which has been specifically provided for this study (for use by the LLFA) is not publicly available; therefore there are restrictions on data use. A number of specific agreements are in place for the PFRA including those indicated below:

- GIS licences for mapping and data supplied by CBMDC
- British Geological Survey (BGS) licence for geological data supplied by GIS
- Environment Agency Standard data licence
- Environment Agency surface water susceptibility maps licence
- Environment Agency LIDAR licence
- Yorkshire Water Data Sharing Protocol

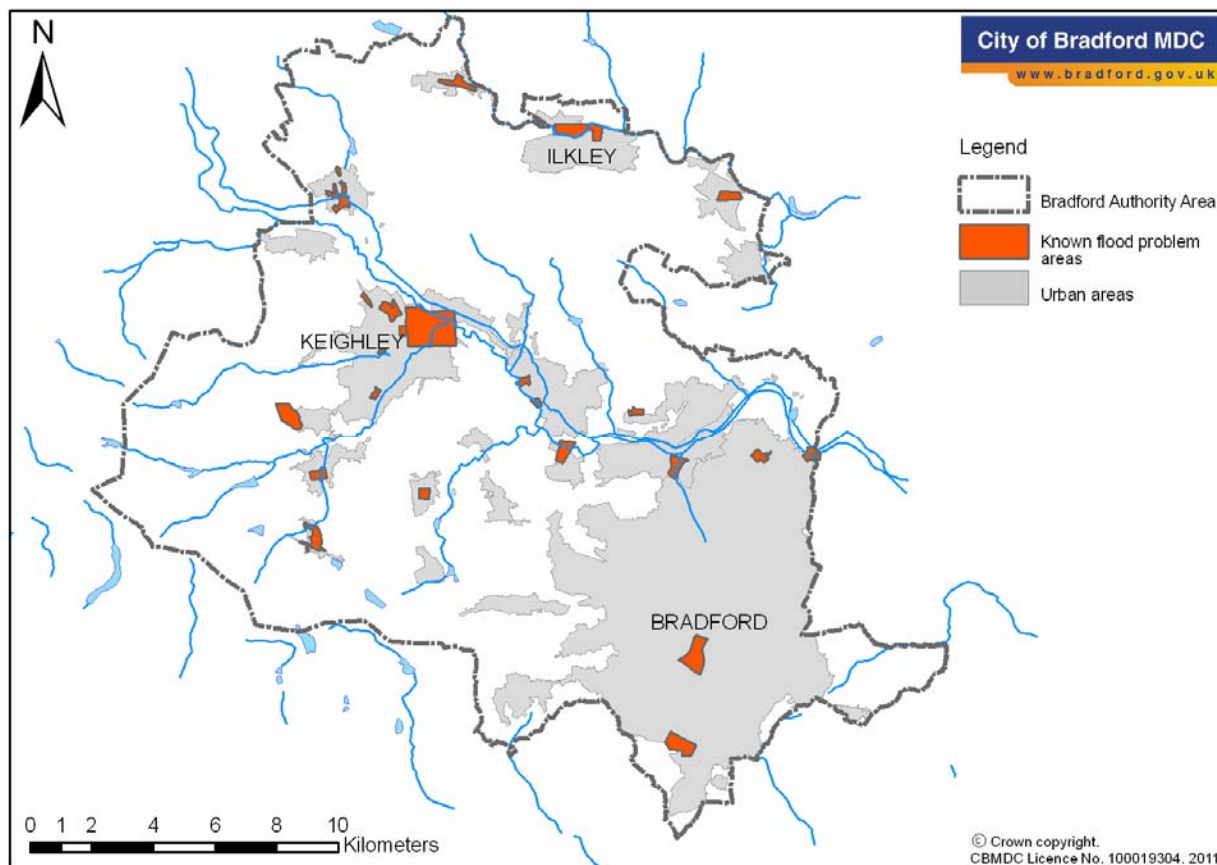
## 4 Historic Flood Risk

### 4.1 Overview of Historic Flooding in Bradford District

Flood records across BD were collected from the data sources identified in Section 3.2. Records of a variety of historical flood events and flooding hotspots were collected across BD. A summary map highlighting the locations of these past flood events is illustrated in Figure 4-1.

These flood events came from a range of flood sources, and in many cases the source of flooding was unknown or not recorded. A summary of information specific to each source of flooding was considered as part of the PFRA is included below.

**Figure 4.1 Known Flood Problem Areas**



### Surface Water Flooding

Surface water flooding occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground. Information on surface water flooding incidents was obtained from a number of sources. Key sources of surface water records were CBMDC and West Yorkshire Fire Service and the Rivers Aire and Wharfe Catchment Flood Management Plans (CFMPs), which are high-level strategic plans published by the Environment Agency that focus on flooding in major river catchments.

### Groundwater Flooding

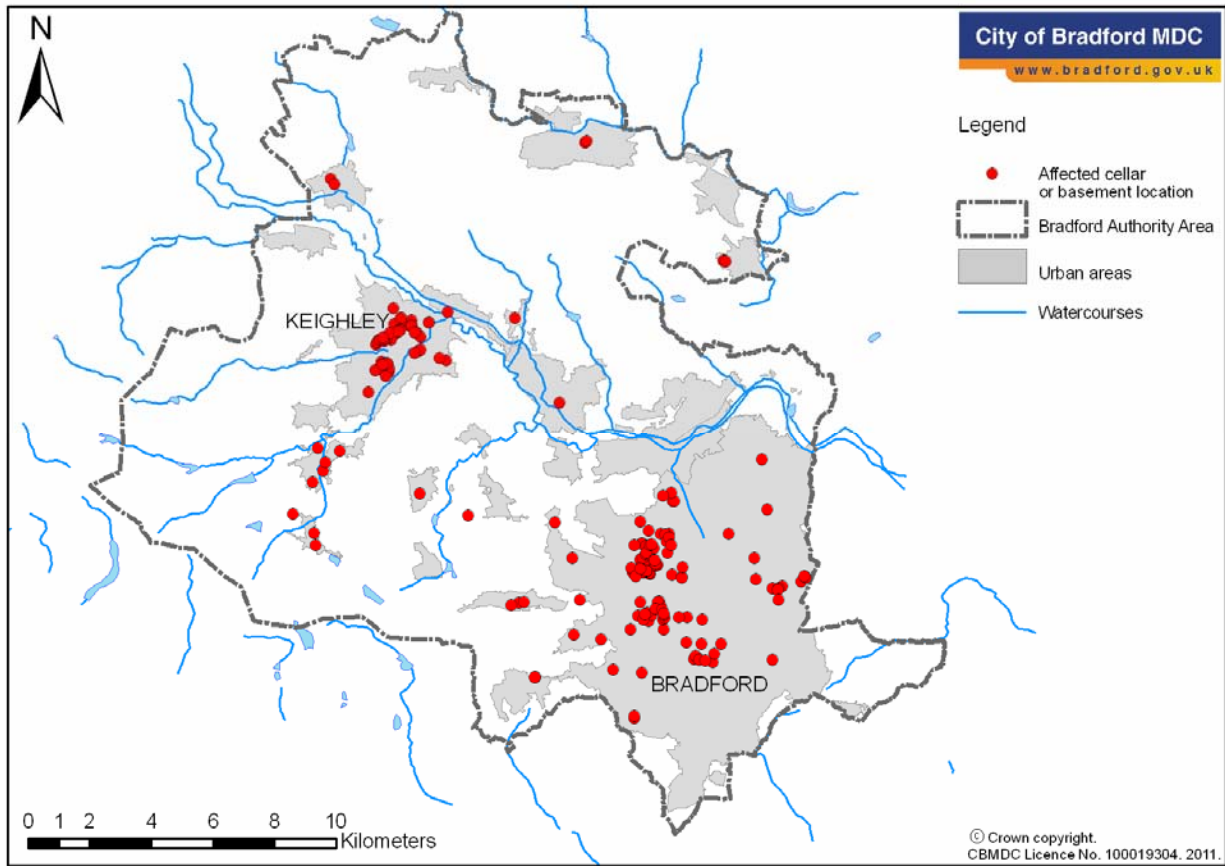
Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth.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

The solid geology of BD is dominated by a clay stratum.

Most records of groundwater flooding were provided by CBMDC's Environmental Health section and related primarily to cellar flooding. See Figure 4.2

. Figure 4.2 Occurrences of Cellar Flooding

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**Sewer Flooding**

Sewer flooding is often caused by excess surface water entering the drainage network. DG5 registers from Yorkshire Water were analysed to investigate the occurrence of sewer flooding incidents across BD. It was found that there were several sewer flooding events that have been recorded by the water company over the past decade. However, these events have not been georeferenced so no comments can be made about their spatial extent and distribution.

In addition, once a property is identified on the water companies DG5 register, it is monitored against trigger criteria designed to provide cost effective solutions to remove properties from that register.

**Ordinary Watercourse Flooding**

Flooding from this source occurs sporadically as a result of infrastructure deterioration, blockage, “under capacity” or a combination of the three. The Council has a team dedicated to dealing with both the practicalities and complex riparian issues associated with such matters and extensive records of “repeating” trouble spots.

**4.2 Consequences of Historic Flooding**

For the purpose of reporting past floods; a flood is deemed significant if it:

- caused internal flooding to five or more residential properties on 5 or more occasions, or
- flooded two or more business premises on five or more occasions, or

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- flooded one or more items of critical infrastructure, or
- caused a transport link to be totally impassable for a significant period.

The definition of “significant period” is dependent on the transport link affected as follows (Highway categories are as set out in Table 1 of the UKRLG Code of Practice for Highway Maintenance).

- Category 1 highways (motorways) and major rail links – 2 hours or more
- Category 2 and 3a highways and other railway links – 4 hours or more
- Category 3b and 4a highways – 10 hours or more
- Category 4b highways – 24 hours or more

As a result of the issues discussed in Chapter 3, Sections 3.3 and 3.4, insufficient data is available to draw definitive conclusions on the impacts and consequences of historic flood events on people, the economy and the environment, as this information has not been adequately recorded in the past.

Due to the lack of readily derivable information available, it is not possible to determine at this point if any historic flood events have been considered to have had ‘significant harmful consequences’ other than the Ilkley event in 1900. This issue will be revisited in future in the Local Strategies.

## 4.3 Interactions with Other Flooding Sources

Insufficient data was available to draw definitive conclusions in this report and due to the complex nature of flooding that occurs in the study area it is considered impossible to solely attribute flooding on these scales to single sources.

The Council owns high resolution LIDAR data for most of its area and methodologies for determining the %age from types of flooding at individual locations is being developed in conjunction with the Pennine Water Group at Sheffield University and may be available in future reports.

## 5.0 Future Flood Risk

### 5.1 Overview of Future Flood Risk

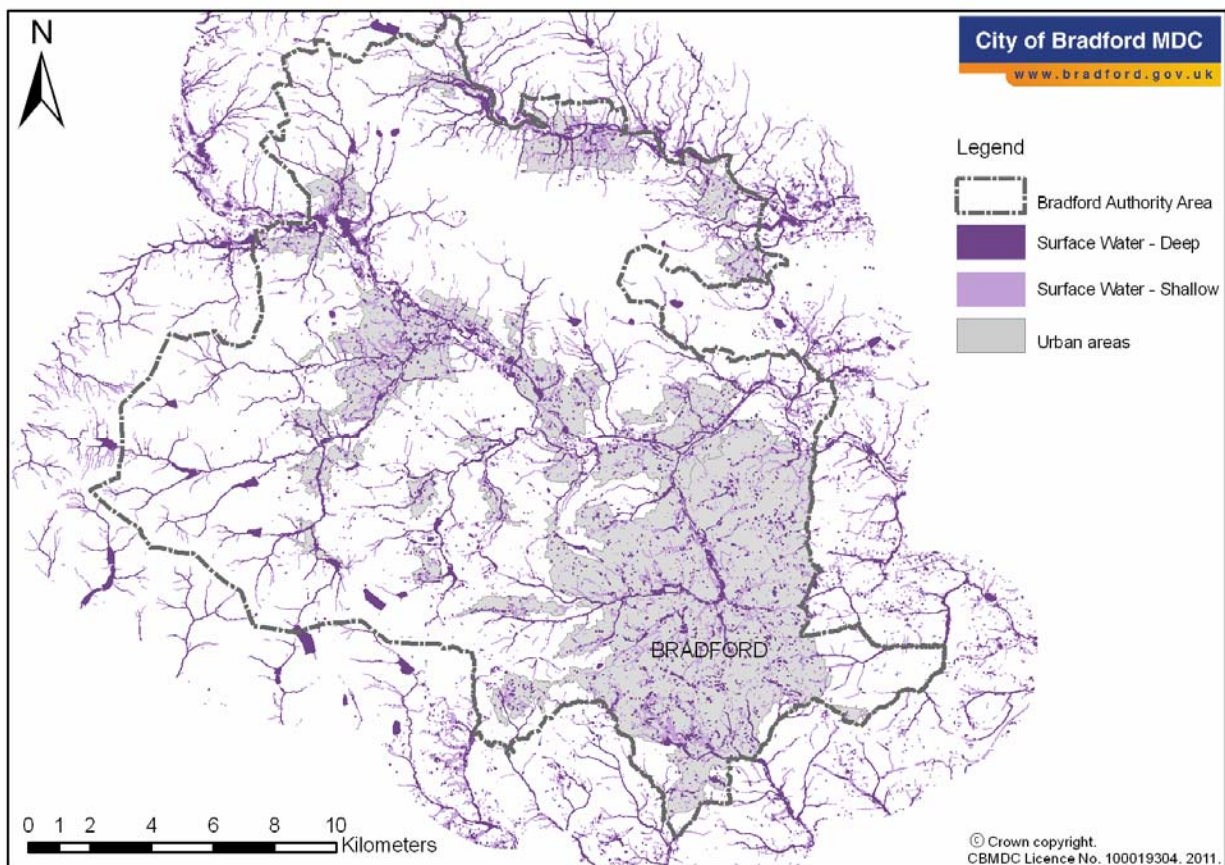
Future flood risk within BD has been assessed as part of the PFRA using methodologies derived from the EU Interreg IVB FloodResilienCity (FRC) project. This involved looking at the District as a whole and assessing potential risk areas based on flooding from a variety of local sources. The key aim of this assessment is to identify areas which are not currently known from past flood incidents.

The DEFRA River Aire IUD pilot study indicated that future climate change scenarios would not produce significant new areas of flooding but due to steep catchments flooding may be exacerbated in existing areas.

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**Surface Water Flooding**

The Environment Agency has produced a national assessment of surface water flood risk in the form of two national mapping datasets. The first generation national mapping, Areas Susceptible to Surface Water Flooding (ASStWF), contains three susceptibility bandings for a rainfall event with a 1 in 200 chance of occurring. The national methodology has since been updated to produce the Flood Map for Surface Water (FMfSW), a revised model containing two flood events (1 in 30 annual chance and 1 in 200 annual chance) and two depth bandings (greater than 0.1m and greater than 0.3m). The EA Flood Map for Surface Water is illustrated in Figure 5-1, highlighting areas at risk of surface water flooding in the future.

**Figure 5.1 Areas at Risk from Surface Water Flooding**



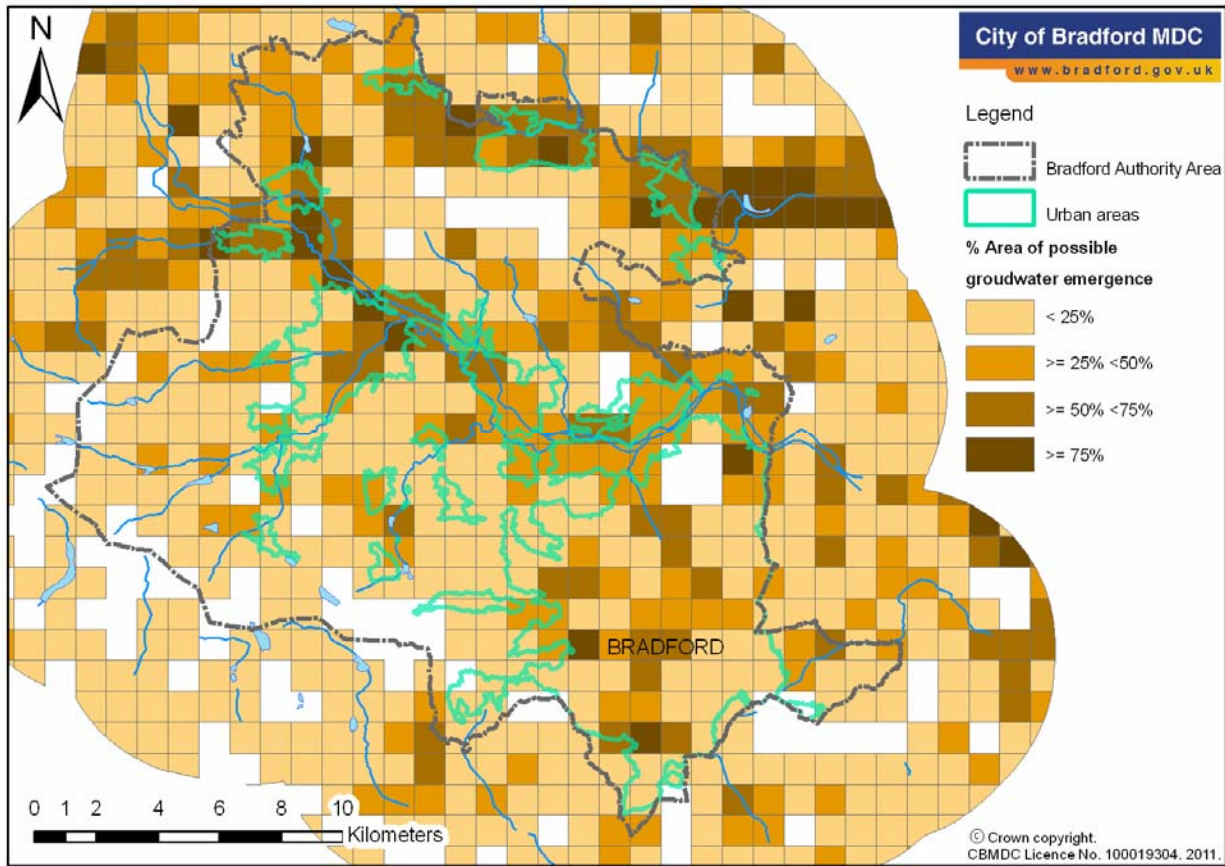
**Groundwater Flooding**

The Environment Agency’s national dataset, Areas Susceptible to Groundwater Flooding, has been used to form the basis of the assessment of future flood risk from groundwater. See Figure 5.2.

There are no local records of significant groundwater flooding available other than in relation to cellar flooding as mentioned in Section 4.1.

**Figure 5.2 Areas Potentially Susceptible to Groundwater Flooding.**

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**Canals and Ordinary Watercourses**

There is no available information on future flood risk from canals. However, British Waterways are currently working on a study to better understand the future flood risk from canals, which will be available to inform the second cycle of the PFRA process.

The fluvial flood map has been used to assess the risk of flooding from ordinary watercourses. Based on this current methodology, no areas were identified that seemed to be at significant risk from ordinary watercourses. However further evaluation of areas within catchments such as the Bradford Beck will be undertaken as part of the Council’s subsequent Local Strategies.

**5.2 Effect of Climate Change and Long Term Developments**

**The impacts of climate change**

The impact of climate change on local flood risk is relatively poorly understood. Several national flood maps have informed the preliminary assessment report - specifically the Flood Map for Surface Water (surface runoff), Areas Susceptible to Surface Water Flooding (surface runoff), Areas Susceptible to Groundwater Flooding (groundwater) and Flood Map (ordinary watercourses). These do not show the impact of climate change on local flood risk.

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There was consensus amongst climate model projections presented in the IPCC fourth assessment report for northern Europe suggesting that in winter high volumes of precipitation are very likely to increase in frequency. These models also project drier summers, but with increased chance of intense precipitation - intense heavy downpours interspersed with longer, relatively dry periods (Solomon et al., 2007).

United Kingdom Climate Projections 2009 (UKCP09) provides the most up to date projections of future climate for the UK (<http://ukclimateprojections.defra.gov.uk>). In terms of precipitation, the key findings are:

By the 2080s, under Medium emissions, over most of lowland UK, central estimates are for heavy rain days (rainfall greater than 25 mm) to increase by a factor of between 2 and 3.5 in winter, and 1 to 2 in summer.

By the 2080s, under Medium emissions, across regions in England & Wales, the central estimate (50% probability) for winter mean precipitation percentage change ranges from +14 to +23 and the central estimate for summer mean precipitation percentage change ranges from -18 to -24.

Certain key processes such as localised convective rainfall are not represented within this modelling so there is still considerable uncertainty about rarer extreme rainfall events for the UK. The proportion of summertime rainfall falling as heavy downpours may increase. The impact of these changes on local flood risk is not yet known.

Current methods of forecasting these events are not sufficiently accurate as to enable them to be used for managing risk.

### Appraisal guidance

Current project appraisal guidance (Defra, 2006) provides indicative sensitivity ranges for peak rainfall intensity, for use on small catchments and urban/local drainage sites. These are due to be updated following the UKCP09 projections above. They describe the following changes in peak rainfall intensity; +5% (1990- 2025), +10% (2025-2055), +20% (2055-2085) and +30% (2085-2115). This was reviewed by the Met Office in 2008 using UKCP09 models (Brown et al., 2008). They suggest that, on the basis of our current understanding, these levels represent a pragmatic but not a precautionary response to uncertainty in future climate impacts. In particular for an event with a 1 in 5 chance of occurring, increases in precipitation intensity of 40% or more by the 2080s are plausible across the UK at the local scale.

### Long term developments

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

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 required to redevelop an area, 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. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria). Proposed areas of regeneration may fall into this category.



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Proposals in the Flood & Water Management Act for the increased use of Sustainable Urban Drainage Systems is due to be brought into effect in 2012 to help counter some of the impact of climate change.

## 6 Flood Risk Areas

### 6.1 Overview

In order to ensure a consistent national approach, Defra and WAG have identified significance criteria and thresholds to be used for defining flood risk areas. Guidance on applying these thresholds has

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been released in Defra's document "Selecting and reviewing Flood Risk Areas for local sources of flooding". In this guidance document, Defra have set out agreed key risk indicators and threshold values which must be used to determine Flood Risk Areas.

The methodology is based on using national flood risk information to identify 1km squares where local flood risk exceeds a defined threshold. Where a cluster of these grid squares leads to an area where flood risk is most concentrated, and over 30,000 people are predicted to be at risk of flooding, this area has been identified as an Indicative Flood Risk Area.

This guidance has now been released and the Environment Agency has applied it to identify Indicative Flood Risk Areas across the country.

**None fall within CBMDC administrative area.**

## 7 Next Steps

### 7.1 Future Data Management Arrangements

In order to continue to fulfil their role as Local Lead Flood Authority, CBMDC is required to investigate future flood events and ensure continued collection, assessment and storage of flood risk data and information.

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It is likely that this requirement will be met most effectively by the Council's existing recording arrangements and new methodologies derived from the EU Interreg IVB Flood Resilient City project. This can be used as an evidence base to inform future assessments and reviews and for input into the mapping and planning stages.

The guidance on requirements for an Asset Data Base has yet to be given by Defra/EA, but this is anticipated within the next 12 months and will constitute a major piece of work both in terms of data collection and recording.

## 7.2 Scrutiny and Review Procedures

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

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

### Local Authority Review

The first part of the review procedure is through an internal Local Authority review of the PFRA, in accordance with appropriate internal review procedures. Internal approval should be obtained to ensure the PFRA meets the required quality standards.

This report will be considered by the Councils Environment and Waste Management Improvement and Scrutiny Committee on the 5<sup>th</sup> July 2011.

### Environment Agency Review

Under the Flood Risk Regulations, the Environment Agency has been given a role in reviewing, collating and publishing all of the PFRA's once submitted.

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

The first review cycle of the PFRA will be led by CBMDC and must be submitted to the Environment Agency by the 22 September 2011. They will then submit it to the European Commission by the 22<sup>nd</sup> of December 2011 using the same review procedure described above.

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