

**Brighton & Hove  
City Council**

**Brighton and Hove City Council**

**Brighton and Hove City  
Preliminary Flood Risk  
Assessment**

**Preliminary Assessment Report**

**Project Ref: 23301/002**

**Doc Ref: R001/ Rev A**

**June 2011**

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## Executive Summary

Peter Brett Associates LLP (PBA) has been appointed by Brighton and Hove City Council (BHCC) to prepare the Preliminary Flood Risk Assessment (PFRA) for the Brighton and Hove Area.

The Flood Risk Regulations 2009 (FRR) Part 2 (Section 10) place a duty upon Brighton & Hove City Council as a Lead Local Flood Authority (LLFA) to prepare a Preliminary Flood Risk assessment by 22<sup>nd</sup> June 2011.

The Preliminary Flood Risk Assessment aims to provide a high level screening exercise to facilitate flood risk management. The assessment involves collection and collation of historic and future flood risk data which will facilitate the identification of Flood Risk Areas (where appropriate) and local Flood Risk Management .

The Environment Agency (EA) issued the national Indicative Flood Risk Areas (iFRAs) to LLFAs in December 2010 based upon a methodology provided by Defra. This identified 10 Flood Risk Areas in England, each area having more than 30,000 people at risk of flooding. The City of Brighton and Hove was ranked as the 8<sup>th</sup> indicative Flood Risk Area (iFRA) in England, with 36,412 people potentially at risk.

As part of the Surface Water Management Plan (SWMP) process, a partnership was set up led by Brighton and Hove City Council (BHCC) to consider and identify local flood risk. The partnership comprised representatives from the EA, the local water utility company Southern Water (SW), BHCC consultant Peter Brett Associates LLP (PBA). Flood risk data and records were requested from the partners and a number of stakeholders outside the partnership in Phase 1 of the SWMP. The GIS database created was then used and developed to incorporate new and revised EA data released to coincide with the requirements of the PFRA.

On review of the Preliminary Flood Risk Assessment, BHCC have decided that they agree with the EA proposed iFRA for Brighton and Hove. However they have chosen to revise the iFRA extent at the administrative boundary with West and East Sussex County Councils. Hence this PFRA will only cover the Flood Risk Area within the administrative boundary of Brighton and Hove City Council.

Based on the EA's national dataset of surface water modelling 17,400 properties are at risk of from to a depth greater than 0.3m during a 1 in 200 annual chance rainfall event.

## 1 Introduction

Peter Brett Associates LLP (PBA) has been appointed by Brighton and Hove City Council (BHCC) to prepare the Preliminary Flood Risk Assessment (PFRA) for the Brighton and Hove City area.

This report identifies and describes the local flood risk and has been written in accordance with Environment Agency guidance 'Preliminary Flood Risk Assessment (PFRA) – Final guidance (2010)' in response to section 10 (Part 2) of the Flood Risk Regulations 2009 (FRR).

The aim of the preliminary assessment report is to provide a high level screening exercise to facilitate flood risk management and fulfil the requirements of the Flood Risk Regulations (and EU Floods Directive). The PFRA will consider flood risk information from a number of data sources, will give a commentary on historic local flood events and the possible harmful consequence of future floods

### 1.1 Legislative Background

The Flood Risk Regulations 2009 (FRR) (statutory instrument No. 3042) came into force on the 10<sup>th</sup> December 2009 and transpose the EU Floods Directive (Directive 2007/60/EC) on assessment and management of floods into English Law. The EU Directive came from European Community Environmental Legislation written in response to cross border European flooding in 2000 and 2004. The FRR comprise seven sections as follows:

- Part 1 – General Provisions
- Part 2 – Preliminary Flood Risk Assessment (PFRA)
- Part 3 – Flood hazard maps and flood risk maps
- Part 4 – Flood risk management plans
- Part 5 – Exceptions
- Part 6 – Co-operation
- Part 7 –Northumbria and Solway Tweed River Basin Districts

In the FRR and the Flood and Water Management Act 2010(FWMA), a Lead Local Flood Authority (LLFA) is defined as either the unitary authority for the area or the county council for the area if there is no unitary authority. As Brighton and Hove City Council is a unitary authority it is therefore a LLFA. The FRR places a duty upon LLFA to prepare the following deliverables:

- Preliminary Flood Risk Assessment Part 2 (Section 10) – by 22<sup>nd</sup> June 2011
- Flood hazard maps and flood risk maps Part 3 (Section 19) – by 22<sup>nd</sup> June 2013
- Flood risk management plans Part 4 (Section 26) – by 22<sup>nd</sup> June 2015

The Environment Agency (EA) must prepare (for each River Basin District) a preliminary assessment map and preliminary assessment report in relation to flooding from:

- The sea
- Main rivers
- Reservoirs

The Brighton and Hove PFRA study falls within the South East River Basin. The South East River Basin runs along the southern coast from Hampshire to East Sussex covering over 10,000 km<sup>2</sup>. The primary rivers that are in the vicinity to Brighton are the River Ouse (East Sussex) and River Adur (West Sussex).

Under regulation 32 (Part 5 Exceptions) of the FRR, the EA have decided not to carry out the preliminary assessment report and have chosen to prepare a flood hazard map, a flood risk map and a flood risk management plan for the entire River Basin District. This option has been chosen because

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the EA have already carried out extensive Section 105 modelling and mapping of the South East. Refer to Appendix A for the South East River Basin District preliminary assessment map.

The LLFA must prepare a preliminary assessment report detailing information about flooding from all local sources with the exception of those listed above. This includes amongst others, surface runoff, groundwater, canals (non main river) and ordinary watercourses. However, the LLFA must also consider the interaction of local sources of flood risk with main rivers, the sea and reservoirs.

## 1.2 Study Area

Brighton & Hove City Council unitary authority area incorporates Brighton and Hove as well as surrounding areas of Patcham, Rottingdean, Woodingdean as shown below in figure 1. The City of Brighton and Hove encompasses an area of approximately 84.5km<sup>2</sup>.

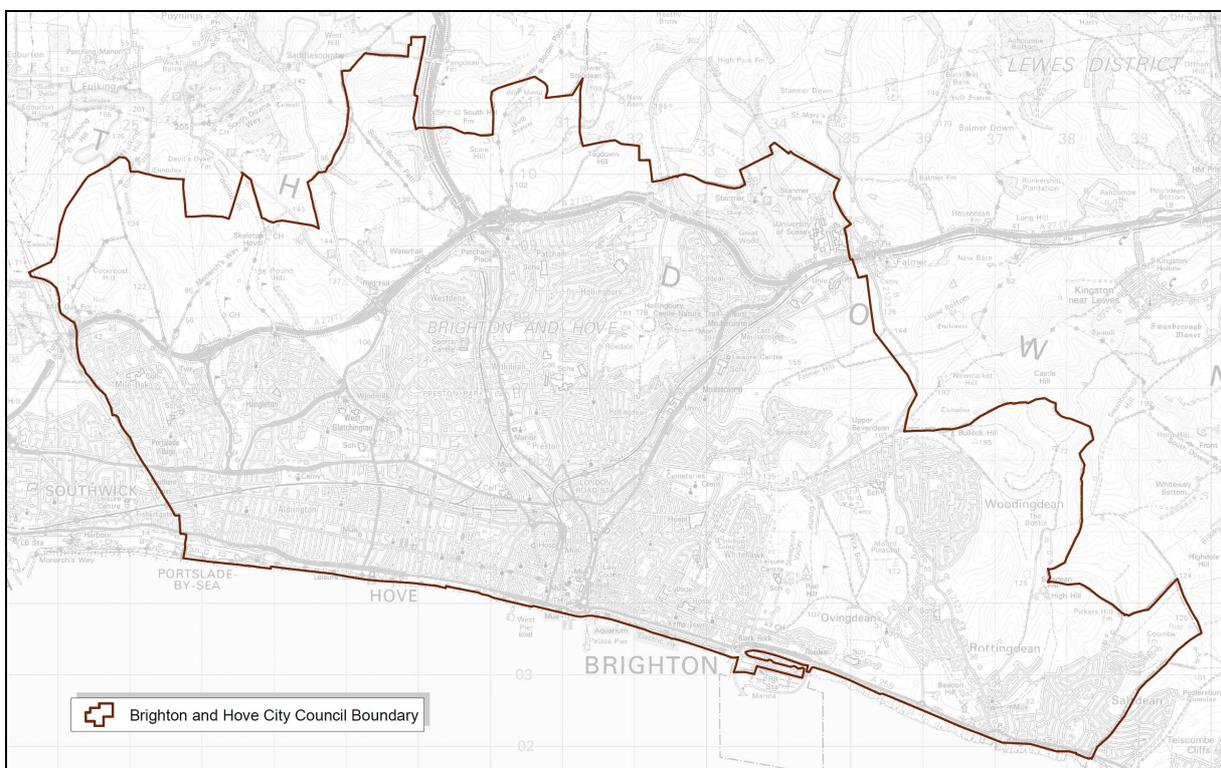


Figure 1 – Brighton & Hove PFRA Study Area

The study area does not include any rivers or canals but is bounded to the south by the sea. Whilst it is not the responsibility of BHCC to consider flood risk from the sea (refer chapter 1.1), the PFRA must consider the interaction of the sea with local sources of flood risk. This flood risk has been predominately identified by the Flood Map which identifies flood zones and shows extents of flooding for a range of probabilities.

Historically, one of Brighton and Hove's most notable flooding event took place just over ten years ago in 2000/2001. Severe surface water flooding and groundwater flooding occurred throughout the City. This is detailed in chapter 4 of this report.

Brighton and Hove lies on a chalk formation. Valleys and the southern areas of the city (adjacent to the sea) have variable superficial deposits consisting of sand, silty clay, local gravel pockets, chalks or flints. Therefore infiltrating drainage systems can and are used to discharge surface water run off where appropriate.

### 1.3 Aims and Objectives

The PFRA is a high level screening exercise which aims to identify where there is risk of local flooding using the best available information. The PFRA report aims to consider flooding (both past and future) from all sources, with the exception of main river, coastal and reservoirs and identify potential Flood Risk Areas. The EA has produced an indicative Flood Risk Area map which has identified 10 significant flood risk areas within England. The City of Brighton and Hove has been identified as a significant Flood Risk Area within England. This is discussed in chapter 6 of this report.

Information from Phase 1 of BHCC's on going Surface Water Management Plan (SWMP), which commenced in 2010, has been used to inform the PFRA. The SWMP is a partnership approach which aims to understand and resolve causes of local surface water flooding. A SWMP identifies flood risk, undertakes different levels of assessment, maps risk and identifies measures and options to mitigate risk. The BHCC PFRA has or will contribute to the same primary objectives as the SWMP which are:

- Collate and map all the existing data relating to surface water flood risk in the local authority area including flood defence and drainage infrastructure (but excluding foul sewers).
- Review of EA national datasets with local knowledge and SWMP database.
- Establish areas where flood risk is currently a problem or where there could be risks in the future as a result of development and/or climate change.
- Identify ownership of drainage features and assets
- Determine an approach to evaluate these problems and to devise potential solutions if practicable.
- Assess, plan and improve current and future drainage asset maintenance regimes using flood risk information.
- Development of future planning strategies and policies to facilitate flood risk mitigation and management.

Prior to the SMWP, PBA produced a Strategic Flood Risk Assessment (SFRA) in 2007 on behalf of BHCC. The SFRA collected records of past flooding, references the EA Flood Map, identified appropriate land uses within flood affected areas and recommend mitigation options to integrate into design of development where flood risk was identified.

## 2 Lead Local Flood Authority Responsibilities

### 2.1 Introduction

The Regulations define new responsibilities for flood risk management, which in part are based on the recommendations of the Pitt Report, and which are consistent with the requirements of the Flood and Water Management Act 2010 (FWMA).

As a Lead Local Flood Authority (LLFA), Brighton & Hove City Council (BHCC) is responsible for managing local flood risk and, under the Flood Risk Regulations (FRR), is required to produce the following deliverables:

- Preliminary Flood Risk Assessment and Flood Risk Areas – by 22<sup>nd</sup> June 2011
- Flood hazard maps and flood risk maps (for Flood Risk Areas) – by 22<sup>nd</sup> June 2013
- Flood risk management plans (for Flood Risk Areas) – by 22<sup>nd</sup> June 2015

This preliminary assessment report forms part of the Preliminary Flood Risk Assessment. The main steps in the preparation to the Preliminary Flood Risk Assessment are as follows:

Item	Description
1	Set up governance & develop partnerships
2	Determine appropriate data systems
3	Collate information on past & future floods and their consequences
4	Determine locally agreed surface water information
5	Complete preliminary assessment report document
6	Records information on past & future floods with significant consequences in spreadsheet
7	Illustrate information on past and future floods
8	Review indicative Flood Risk Areas
9	Identify Flood Risk Areas
10	Records information including rationale

Table 2.1 Steps to PFRA (PFRA Final Guidance, EA (2010))

The Preliminary Flood Risk Assessment (PFRA) guidance states that ‘Partnership working is essential in the management of local flood risk’. As such, a LLFA is required to set up appropriate partnerships and governance which will facilitate collection and sharing of data, as well as aiding the management of the PFRA. The importance of sharing and working together to collect data is enforced in Regulation 35 (Duty to co-operate) and Regulation 36 (Power to require information) of FRR and is re-enforced by the partnership approach.

Under the FWMA, LLFA’s have a duty to develop, maintain, apply and monitor a strategy for local flood risk management. The Environment Agency (EA) is required to produce a national strategy for Flood and Coastal Erosion Risk Management (FCERM) for England. The Act requires local strategies to be consistent with the national strategy. The local strategy will be based on an assessment of risk and will use the data collected as part of the PFRA process. Preliminary Framework guidance for development of local strategies was released by the Local Government Group in February 2011.

In addition, a LLFA will also have the following responsibilities as part of the FWMA:

- Duty to investigate and to maintain a register
- Powers to carry out works to manage flood risk.
- Designation of third party assets
- SuDS approving Body (SAB)

## 2.2 Partnership approach

As part of the Surface Water Management Plan (SWMP) process, a partnership was set up led by BHCC to consider and identify local flood risk. The partnership comprised representatives from the Environment Agency (EA), the local water utility company Southern Water (SW) and BHCC consultant Peter Brett Associates LLP (PBA).

The partnership arrangement allowed the sharing of information and data to identify all sources of local flood risk, which was consolidated into a GIS database. The SWMP partnership was also used to discuss the requirements of the FRR and delivery programme for the Preliminary Flood Risk Assessment (PFRA). The existing SWMP GIS database was used and developed to incorporate new and revised EA data released to coincide with the requirements of the PFRA.

## 2.3 Stakeholders

Other stakeholders outside the partnership were also contacted to obtain information and data. These included East Sussex Fire and Rescue Service, Network Rail, Highways Agency and South Downs National Parks Authority.

To date the BHCC SWMP has not included public consultation or communication as the SWMP is in the Phase 1 Preparation stage. However it is envisaged that community engagement will form part of the Phase 4 Implementation and Review stage potentially involving information and educational literature and/ or workshops. The aim of this will be to raise awareness of the issues and identify ways in which home owners can help to protect themselves.

BHCC has historically carried out limited community liaison and engagement prior to and following major flood events. BHCC were contacted during the extreme rainfall event in winter 2000/2001 to assist with emergency situations. This included advising residents on preventive measures and cleaning up after the event. During the winter flooding of 2000/2001 several members of the highways department were posted to affected areas to speak with the public and co-ordinate road closures.

## 3 Methodology and Data Review

### 3.1 Methodology

As part of the Surface Water Management Plan (SWMP) Phase 1 data collection process information was gathered from a number of sources. This database has formed the foundation for the Preliminary Flood Risk Assessment (PFRA) database.

### 3.2 Data Collection and Review

#### 3.2.1 Brighton & Hove City Council (BHCC)

Internal departments at BHCC were able to provide the following data:

- CityClean – Locations of known soakaways
- Education – Location schools and anecdotal flooding information.
- Estates – Location of all BHCC Estate Land
- Highways – Flooding photos, anecdotal information on historic flood events, ‘Flood Defence Assessment of Downland Flooding’ (Binnie Black & Veatch, 2001) (report commissioned following the winter flooding in 2000/2001), Brighton Flood Defence Structures Condition Survey and Maintenance Brief (2007) and Bevendean Flood alleviation Structures maintenance manual (BHCC, 2006).
- Parks – Details of a complaint concerning flooding at a specific location within the city.

The Planning, Risk and Insurance departments at BHCC were also contacted to obtain flood risk information, however PBA were informed they did not hold such records

#### 3.2.2 Peter Brett Associates LLP (PBA)

PBA prepared the BHCC Strategic Flood Risk Assessment (SFRA) on behalf of BHCC in 2008. This document was used to identify any other forms of flooding that had not been sourced by other data providers. The underlying database to the SFRA was acquired which included groundwater flooding, highway flooding, sewer flooding, flood history as well as proposed development locations.

#### 3.2.3 Southern Water (SW)

All Southern Water asset records for combined and surface water were provided for use in the SWMP and PFRA subject to completion of a data sharing protocol. In addition, the Sewer Incident Record Form (SIRF) for the City was provided indicating areas of historic sewer flooding.

#### 3.2.4 Environment Agency (EA)

- LiDAR data –Light Detection And Ranging data, which provides detailed elevation data to map terrain. However, the dataset for Brighton and Hove was incomplete and only areas of LiDAR in proximity to the coastline were provided.

The following data was release by the EA in accordance with PFRA requirements via their Geostore website and was included within the GIS database:

- Maps of Areas Susceptible to Groundwater Flooding (AStGWF).
- Maps of Areas Susceptible to Surface Water Flooding (updated) (AStSWF).

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- Detailed River Network – shows fully attributed river centrelines.
- Flood Map - identifies EA fluvial and coastal flood zones.
- Flood Map for Surface Water (FMfSW) 1 in 30 yr chance of flooding in any year.
- Flood map for Surface Water (FMfSW) 1 in 200 yr chance of flooding in any year.
- Historic Flood Map- shows the combined extents of flooding from rivers and groundwater.
- Historic Landfill – shows sites where there is no PPC permit or waste management licence currently in force.
- National Receptor Database (NRD) – details receptors which are impacted by flood risk, this includes information on agriculture, buildings, environment, heritage, land use, miscellaneous, transport and utilities.

Further information was provided by the EA to assist the preparation of the PFRA. This includes Environmental sites, parks and world heritage sites. The risk of flooding (using FMfSW) has been assessed for each of these sites. The Flood Map has been used to exclude coastal flooding and show flood risk from surface water only. This parks data has been presented with the National Receptors database for the purposes of this PFRA (see figure 5.6).

#### **3.2.5 Network Rail (NR)**

PBA requested all Network Rail track drainage records in the Brighton and Hove study area. At the date of this report this information had not yet been received.

#### **3.2.6 East Sussex Fire and Rescue Service (ESFRS)**

PBA requested all Fire Brigade records for flooding within the last ten years. The ESFRS provided flooding events for the Brighton and Hove area which was subsequently sorted for clear surface water flooding events only.

#### **3.2.7 Highways Agency (HA)**

The Highways Agency required a Memo of Understanding to be signed by BHCC to release data. Once this was completed they provided flood related data on the location of all Highways Agency assets as part of their Highways Agency Drainage Data Management System (HADDMS). This is used within the Agency and by the Agency's supply chain as their central repository for drainage data and associated information.

### 3.3 Flood Risk

The Flood Risk Regulations 2009 (FRR) defines Flood Risk as ‘a combination of the probability of the occurrence with its potential consequence’ (Part 1, Regulation 3). As defined in the PFRA guidance, consequences of flooding can be negative or positive. This includes consequences to human health, economic activity and the environment (including cultural heritage).

Indicators have been recommended by the PFRA guidance in order to identify significant consequences (as shown in table 4.1 below).

Consequence	Indicator
Human health	1. Number of people * 2. Number of critical services
Social and Economic activity	1. Number of non-residential properties 2. Infrastructure network 3. Area of agricultural land
Environment	1. Consequence of pollution 2. Impact on internationally and nationally designated environmental sites 3. Impact on internationally and nationally designated heritage assets.
Cultural Heritage	1. World Heritage Site 2. Scheduled Monuments 3. Listed Buildings 4. Registered parks and gardens

Table 3.1. Indicators to identify consequences. \*Number of people defined as 2.34 multiplied by the number of properties.

A number of indicators to the consequence of flooding were provided in the National Receptors Database (NRD), which details datasets for a number of themes as shown in figure 3.1.

Theme	Layer	Theme	Layer
Agriculture	Agricultural Land Classification	Land Use	Country Park
Buildings	NRD Property Points		National Parks England
Environment	International Designations		National Trail England
	Local Designations	Miscellaneous	Lower SOAs (Full)
	Misc Designations		Lower SOAs (Generalised)
	National Designations		Middle SOAs (Full)
Policy Designations	Middle SOAs (Generalised)		
Heritage	Battlefield England	Transport	Railways
	Heritage Sites		Roads
	Listed Buildings	Utilities	Active IPPC
	Park & Garden		Active RAS Auths
	SAM		Active RAS Registrations
	WHS		Waste Licences REGIS

Figure 3.1 National Receptors Database layers (National Receptor Dataset, EA (2010))

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Whilst figure 3.1 provides a comprehensive list of data, during the PFRA process it was noted that not all dataset are complete. For example the Environment International Designations (such as Special Area of Conservation (SAC) and Sites of Special Scientific Interest (SSSI)) and Agriculture within the Brighton and Hove area do not appear on the database. However these items have been included in the EA information for reporting.

The NRD also details building types which allows property counts to be undertaken for different building types (in accordance with 'Flood Map for Surface Water- Property Count Method', EA, 2010). As detailed in section 3.5.1 of this report, historical records on flooding do not contain detailed information on the flooding event nor the consequence of the event. Hence, historical flood risk is difficult to quantify.

### 3.4 Data quality

#### 3.4.1 Quality Assurance

The data described in Section 3.2 of this report has limited application. As discussed, the BHCC data is based on anecdotal accounts of flooding events, and whilst a wide range of locations have been included, details are not available on extents, depth or durations of flooding.

Network Rail has been unable to provide any of the requested drainage information. Network Rail land was a key source of flooding at Patcham during the 2000/2001 flood event. As a result there was disruption for approximately 5 days on the London to Brighton rail line. Groundwater was reported to have built up behind the railway embankment to the north of the A27, as a result of emerging springs. The railway line at this location was flooded and it is thought that the head of water forced through the embankment and emerged in a soakaway in the petrol station at the Patcham roundabout (refer to 'Flood Defence Assessment for Downland Flooding', Binnie Black & Veatch (2001)). An alternative theory is that because groundwater levels were high due to repeatedly long duration storms, the large quantities of water emerging from the soakaway could be attributed purely to groundwater flooding. However, as Network Rail data has not been received there is limited information concerning this area.

The East Sussex Fire and Rescue Service (ESFRS) data was sorted to include only events that were clearly identified as surface water flooding issues. As such there is a number of additional surface water flooding records which could potentially be included in the database, however due to reporting limitations a conservative rationale has been applied to the use of this data.

Highways Agency (HA) data was provided in the form of their Drainage Data Management System (HADDMS), which was introduced in 2006. 'The Highways Agency Drainage and Flood Data Description', Highways Agency (2010), states that this system currently contains approximately 55% of the data on the type and location of HA drainage assets. The sources of this data vary from digitised drawings (not yet validated by field survey), as-built drawings, design drawings for a drainage scheme that was not actually built and recent field surveys. Hence the quality and reliability of the data provided is varied. There are clear gaps in the database, which have been identified within Brighton and Hove. This includes an attenuation tank located underneath the Patcham roundabout and a number of soakaway located in Wilde Park. Both of these assets are known to be the responsibility of the Highways Agency yet are not contained within the HADDMS.

The data quality has been considered at each stage of the SWMP and PFRA. The SWMP guidance emphasises the importance of understanding uncertainty or weakness in the data. The SWMP guidance provides the following information on data quality.

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Data Quality Score	Description	Explanations	Example
1	Best possible	No better available; not possible to improve in the near future	High resolution LiDAR, River/sewer flow data, rain gauge data
2	Data with known deficiencies	Best replaced as soon as new data are available	Typical sewer or river model that is a few years old
3	Gross assumptions	Not invented but based on experience and judgement	Location, extent and depth of much surface water flooding.  Operation of un-modelled highway drainage.  'Future risk' inputs e.g. rainfall, Population.
4	Heroic assumptions	An educated guess	Ground roughness for 2d models

Table 3.2 Recording the quality of data (SWMP Technical Guidance, March 2010)

In accordance with the above table, a data quality score has been applied to all the data collated from BHCC and stakeholders. The data score is summarised by the data provider and detailed in table 3.3 below.

Source of data	Data Quality Score	Description
Brighton and Hove City Council	3	Gross assumptions
Southern Water	2	Data with known deficiencies
Environment Agency	1	Best possible
East Sussex Fire and Rescue Service	3	Gross assumptions
Highway Agency	3	Gross assumptions

Table 3.3 Data quality of BHCC PFRA data

### 3.4.2 Data Storage

The majority of flood risk and drainage asset data collected for the SMWP Project was provided in a variety of electronic formats, and was converted to shape files (where necessary) and imported into Esri Arc GIS software. Within this software the files are stored in a geo referenced database. Any hard copy information received was either drawn in AutoCAD then converted or data was manually entered into the database.

### 3.4.3 Data security

BHCC, SW and PBA signed a data sharing protocol in order to acquire information on SW's drainage assets and SIRF.

EA data was sourced by BHCC from the EA Geostore website. BHCC is licensed by the EA to use this data for the preparation of their PFRA.

The Highways Agency supplied their data following a Memo of Understanding being signed by BHCC.

## 4 Past Flood Risk

### 4.1 Overview

As described in chapter 3, a variety of stakeholders were consulted to obtain records on past flooding events within the Brighton and Hove City area. Historical flood records are illustrated on figure 4.1, figure 4.2 and drawing 23301/002/SK01 (refer to appendix A).

There are several documents which have aimed to identify past flooding within the Brighton and Hove study area. The SFRA carried out in 2008 sought to collate known sources of flooding, identify Flood Zones, recommend appropriate land uses and recommend potential flood mitigation measures for flood risk areas.

A River Adur Catchment Flood Management Plan (CFMP) summary was issued by the EA in December 2009. The SWMP, as previously discussed, is the latest assessment of flood risk aiming to understand and resolve local flooding. The SWMP has been progressed up to Phase 1 (Preparation).

Historically, one of Brighton and Hove's most notable flooding events took place in 2000/2001. Surface water flooding and groundwater flooding occurred throughout the City as a result of intense rainfall. A variety of locations were affected by flooding, for example urban areas adjacent to the Downs which were affected by Downland flooding, as well as locations within the city which were affected by groundwater flooding.

### 4.2 Local information about past floods

#### 4.2.1 Sewer Incident Report Form (SIRF) – Sewer Flooding

The SIRF from Southern Water shows the location and date of historic flooding on the surface water and combined network within Brighton and Hove.

#### 4.2.2 Brighton and Hove City Council

There are no formal records of historic flooding events held by Brighton & Hove City Council. However there are members of staff within BHCC Highways department who have a wealth of knowledge on historic flooding events. A workshop was held with members of the highways department and the BHCC Emergency planner to record this information and inform this Preliminary Flood Risk Assessment. The highways department held a number of photographs of the 2000/2001 flooding which can be found in Appendix D. In addition, PBA also met with the Head of Capital Strategy and Development Planning to establish historical events at Education properties.

There has been a wide range of flooding events throughout the city over the last 15 years. One of the most notable events occurred just over 10 years ago, which was the winter 2000/2001 flooding event where extreme weather conditions resulted in flooding throughout the city.

Following the extreme event of 2000/2001 BHCC appointed a consultant to investigate the causes and effects of winter flooding. This concentrated on 8 specific locations within the city. The results of this study can be found in the report 'Flood defence Assessment of Downland Flooding', (Binnie, Black & Veatch, 2001).

As discussed above, the BHCC past flood risk data is based upon anecdotal records. Whilst this has provided a coverage of the past flood risk within the city, the detail of data has weaknesses with dates, depth, duration etc. missing. The 'Flood defence Assessment of Downland Flooding' (Binnie, Black & Veatch, 2001), instructed by BHCC, provides more detailed information on some flooding events during the winter 2000/2001 flood event.

#### 4.2.3 East Sussex Fire and Rescue Service (ESFRS) Records

The ESFRS provided all flooding event data for the last 10 years which was sorted to include only those that specifically imply they were surface water related.

The data only includes the year, location and brief description. This filter of data resulted in 20 records of flooding events over the 10 year period. There is no consequence or indicator stated for any of these records and so for these records it is considered that there were no significant consequences. As per the PFRA guidance these records will not be included in the preliminary assessment report spreadsheet. However a few records do state the consequences and have been included in the spreadsheet.

#### 4.2.4 Strategic Flood Risk Assessment (SFRA)

As part of the SFRA carried out by PBA on behalf of BHCC in 2007, data collection of historical flooding was carried out. This included flooding issues from surface water, groundwater and sewer flooding. The database does not contain any information on the flooding events. As per the PFRA guidance these records will not be included in the preliminary assessment report spreadsheet.

All local information on past floods is shown on figure 4.1.

### 4.3 National information about past floods

The Environment Agency (EA) Historic Flood map was obtained for the Brighton & Hove City area. This shows the flood extent from records of flooding from the sea and groundwater only. This can be seen in figure 4.2. Whilst part of this relates to sea, which can be excluded from this PFRA as it is the responsibility of the EA, the historic flooding from Groundwater still needs to be considered. Unfortunately this dataset cannot be separated to identify the two individual sources. The PFRA guidance states that a Historic Surface Water and Groundwater geodatabase (HSWGW) will be released in the future, which will be used in the next PFRA cycle to provide a better understanding of historic flooding events.

### 4.4 Consequences

As discussed in chapter 3.3 and as defined by the PFRA guidance, a flooding event can have consequences on the following categories:

- Human health,
- The social and economic welfare of individuals and communities,
- Infrastructure,
- The environment (including cultural heritage).

Indicators have been recommended by the PFRA guidance in order to identify significant consequences (as shown in table 3.1). Each of the historical events listed in the chapter 3.2 was collated via a GIS database and viewed alongside indicators for consequences of flooding.

### 4.5 Annex 1

Annex 1 of the Preliminary Assessment Spreadsheet details the significant harmful consequences of past flooding events, which have been considered as part of this PFRA. Data has not been included where the consequence of the flooding event is not known. Consequences have been assessed using the indicators discussed in chapter 4.4. It is anticipated that a more complete record of information relating to flooding events will be kept in the future which will allow a more informed PFRA for the next cycle.

## 4.6 Summary

A summary of past flood events and associated significant harmful consequences contained in Annexe 1 is shown in table 4.2 below. As discussed above, some data has insufficient information to fully establish the consequences of the all flooding events, however there is some limited available information and therefore it has been assumed that for instances listed in table 4.2 there is a significant consequence.

Flood Event	Flood Date	Location	Description	Consequences
1	Autumn/Winter 2000/2001	Woodingdean - Falmer Road at Millyard Crescent	In Autumn/ Winter 2000/2001, Water flowed down Falmer Road and collected at Millyard Crescent. This was caused by storm runoff from recently ploughed fields and also a hedge was removed.	Economic – flooded road
2	2000	Woodingdean - Falmer Road at Millyard Crescent	There is a large soakaway at the bottom of the hill in the field located at the low point of the road. The Farmer in the adjacent field is required to leave a strip of land unploughed adjacent to the road. In 2000 Falmer Road at Millyard Crescent flooded. A super gully has been installed at this point.	Unknown
3	Unknown	Falmer Road Junction with Cowley Drive	Flooding is caused by lack of capacity of the soakaway on Falmer Road at the junction with Cowley Drive. The area floods on regular occasions, although it only floods the field and road.	Economic – Highway disruption.  Environmental – flooded field.
4	Autumn 1995	Longhill School	In Autumn 1995, flooding took place on the playing field only (This was the low point). Flooding was generally muddy downland runoff from the fields to the east of Falmer Road. However since then there has been a new extension to the school which is potentially at risk.	Economic – School Closed. Environmental – School playing field flooded
5	Winter 2000/2001	Ovingdean - Kett's Ridge	Surface water runoff from the field to west of Ovingdean Close caused flooding to house and garden during the winter of 2000/2001.	Human Health – House
6	2000	Top of Saltdean vale, Tumulus Road and the junction to football pitches	In 2000, runoff from farm onto the highways caused flooding. A new soakaway has been installed and no problems have occurred since 2000.	Economic – Highway flooded
7	Unknown	Rottingdean - High Street	This area used to flood from runoff from the Downs (however not for the last 20 years). There is still some minor highway flooding which occurs at this location.	Unknown
8	November 2000	Lewes Road - opposite Wild Park	High groundwater levels caused springs to emerge in Wild Park and flood road in November 2000. Two lanes of the four way carriageway were closed (one lane in either direction closed for 2 weeks).	Economic - Flooded road. Environmental - Flooded park

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9	November 2000	Lewes Road - under the railway bridge at Moulsecroomb	High groundwater levels caused springs to emerge in Wild Park and flood road in November 2000. Two lanes of the four way carriageway were closed (one lane in either direction closed for 2 weeks).	Economic - Flooded road. Environmental - Flooded park
10	November 2000	Lewes Road - at the junction with the Avenue	High groundwater levels caused springs to emerge in Wild Park and flood road in November 2000. Two lanes of the four way carriageway were closed (one lane in either direction closed for 2 weeks).	Economic – Flooded road. Environmental - Flooded gardens
11	2000	Moulsecroomb Primary School	Flooding occurred in 2000 when runoff from the playing field flooded boiler room.	Unknown
12	2000	The Avenue	Groundwater emerged out of gardens in The Avenue in 2000 from natural springs, however there have been no occurrences since 2000. There have been localised maintenance issues, gulleys blocked and pipes collapsed which caused local ponding only.	Economic – Flooded Road
13	Unknown	The Level, Union Road, Lewes Road	The area drains to a Southern Water sewer. Flooding of the highway occurred due to lack of highway maintenance.	Economic – Highway disruption
14	15 <sup>th</sup> September 2000	Bevendean - Heath Hill Avenue	In September 2000 surface water runoff flowed down Hill Heath Avenue.	Human Health - Heath Hill Avenue flooded
15	12 <sup>th</sup> October 2000	Bevendean - Heath Hill Avenue	In October 2000, surface water runoff caused flooding in Heath Hill Avenue	Economic – Parade of shops and pub flooded.  Human Health - 25 houses flooded along Heath Hill Avenue, Bodiam Close, Bodiam Avenue and Leybourne Parade as well as community centre. Bevendean School was flooded.
16	Autumn/Winter 2000/2001	Bevendean - Bodiam Close	In Autumn/ Winter 2000/2001, overflow from Bevendean Cascades flooded the road in Bodiam Close and BHCC had to empty ponds using tankers to confine flooding to roads.	Human Health - Houses flooded in Bodiam Close.  Economic - Flooded road in Bodiam Close
17	08 <sup>th</sup> February 2001	Bevendean - Bodiam Close	In February 2001, a damaged valve chamber at foot of Bevendean Cascades caused flooding in Bodiam Close.	Economic - Flooded road in Bodiam Close
18	2000	Bevendean Primary School	In 2000, flooding occurred at Bevendean Primary School from downland runoff.	Economic - School flooded

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19	Unknown - up to 3 times a year	Whitehawk Road junction with Roedean Road	All drainage on Whitehawk Hill is on soakaways which are often by-passed or overwhelmed causing flooding. Run off flows down the road and the road flattens where the Southern Water sewer starts. Flooding is often caused by debris, leaves and litter.	Economic – flooded road
20	Unknown	Bottom of Wilson Avenue	Flooding occurs at the bottom of the hill on Wilson Avenue, where the soakaways gets overwhelmed and the water lays on Council land until it soaks into the ground.	Economic – flooded road. Environmental – parkland flooded.
21	07 <sup>th</sup> November 2000	Patcham	In November 2000, springs broke out of railway cutting to the north of Patcham and water flowed along railway line. It is assumed that the head of water forced flow through the embankments and emerged from soakaways by the Q8 petrol station. Gullies were not large enough to drain water.	Economic - A23 closed for 2 weeks. London to Brighton railway line closed. Environment - Park flooded
22	15 <sup>th</sup> December 2000	Patcham	As groundwater levels increased, dilute foul sewage emerged from sewers into the streets at Patcham and Preston Park as they became surcharged.	Human Health – dilute foul sewage emerged into the streets as sewers are surcharged
23	11 <sup>th</sup> February 2000	Patcham	Groundwater levels increased causing flooding in the basements of Old London Road.	Human Health - Basements along Old London Road - water starts to reappear as groundwater rising
24	2000	St Bernadettes R.C. Primary School, London Road	The A23 outside St Bernadettes school has flooded in the past, however the school is on a hill. Therefore access was an issue (Related to Patcham flooding)	Human Health – flooded school
25	2000	A23 South Road	There is a Highways Agency storage tank in the roundabout at the A23 and A27 at Patcham which has a designed discharge into the Southern Water sewers downstream through to the storm tunnel under the beach. There is a capacity issue at the junction between the A23 and South Road where 2 sewers merge into one and hence there is a throttle on the system. The area last flooded in 2000, since when there have been alterations to the traffic junction which may have reduced the risk.	Economic - Highway disruption
26	Unknown - regularly floods	Carden Avenue / Warmdene Road area	The highway drainage upstream of this area is drained via soakaways and when the soakaway capacity is exceeded, overland flows occur. This overland flow causes flooding at Warmdene Road and the junction with Carden Avenue. No flooding has occurred for approximately a year but previously this would flood several times a year. Generally, this is just flooding on the highway but has damaged some properties in the past.	Economic - Highway disruption

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27	Unknown	Vale Avenue junction with Mackie Avenue	Water from the hill and the highway accumulates at the low spot. The BHCC highway drain needs cleaning and could be blocked. At the junction, it floods a couple of times a year but is confined to highway.	Economic – flooded highway
28	2000/2001	Millcroft, Westdene	In 2000/2001, there was a complaint from a resident for this site. The lined dew pond in fields to the rear of the property overflows into the back garden.	Unknown
29	Autumn/Winter 2000/2001	Rear gardens of 63 and 65 Millcroft, Westdene	The dew pond was enlarged and lined to retain water, as a result it can overflow and cause flooding in gardens. A resident made a complaint to BHCC via Parks.	Unknown
30	Unknown	Tongdean Lane	Flooding occurred several times a year at Tongdean Lane, although it is not longer an issue as the highway has been re-graded and additional highway drainage has been installed. The property with a basement has a pump. The area lies at a natural low point and requires regular highway drainage maintenance. Highway drainage goes into a ditch, which is virtually flat and it discharges into land at Withdean Stadium where it enters the Southern Water network.	Economic – flooded highway
31	11/12 <sup>th</sup> October 2000	Mile Oak Road - 417 & 419, near junction of Nursery Close	The runoff from land to the north of A27 goes down Mile Oak road before ponding by the junction with Nursery Close. The water then burst through back gardens and flooded houses.	Human Health – houses flooded
32	Early to mid Nov 2000	Mile Oak Road, Beechers Road, Heathfield Crescent, Heathfield Drive, Oakdene Crescent, Oakdene Gardens, Wickhurst Rise, Compass Court and Valley Road	Groundwater flooded the cellar of Mile Oak Inn up to 1.3m depth which had to be pumped out. Springs emerged in back gardens in the area. Some of this springwater is thought to flow overland and may enter the foul sewerage systems, thereby contributing to the foul flooding in The Green area of Southwick.	Economic – Highway flooded
33	2000	Mile Oak Road	Flooding is caused by runoff from Mile Oak Farm as a result a terrace of cottages flooded when the soakaway was full. There was ponding of floodwater in the street whilst the soakaway discharged water. This was compounded with groundwater flooding in 2000. There has been no recent flooding.	Human health – properties flooded

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34	Unknown	North Portslade - South Street Cottages	The area drains to a Southern Water sewer which is over capacity in times of heavy rainfall. There is also believed to be water flowing down the valley through valley gravels which add to the problem. This has links to Abinger Road and Vale Road issues. South Street cottages flooded due to lack of maintenance on the road gulleys, which once cleared, resolved the flooding issues. Southern Water installed two storm tanks in 2007 to reduce the risk of flooding; one on the foul sewerage system and one on the surface water sewerage system.	Human health – properties flooded
35	Unknown	Benfield Way and junction will Hillside	Benfield Way is served by a surface water sewer but the roads uphill are drained by soakaways. When the soakaway capacity is exceeded there is overland flow of water into Benfield Way. Ponding occurs outside No. 53 and Southern Water have protected the property with mitigation measures and re-opened an overland flowpath.	Economic - Flooded highway
36	Unknown - occurred once or twice a year	Abinger Road, Portslade	Flooding at Abinger Road used to occur 3 times a year with both road and property flooding. All properties now have valves on toilets. The problem clears in approximately 20 mins once the storm passes. The existing surface water sewer in Abinger Road may be hydraulically overloaded. Flood mitigation works were carried out to protect properties.	Human health – properties flooded
37	Unknown	Elm Road, Portslade	Flooding occurred when system backs up into properties at Elm Road. Valves have been installed so that toilets in properties do not flood when the system backs up at peak flow.	Human health – properties flooded
38	Unknown	The Drive Junction with Upper Drive	Flooding was caused by the overland flow of surface water and gullies which were blocked by leaves. A highway Super Gully was installed at the low spot and flap valves were installed in properties in Wilbury Avenue. There have been no problems for 4/5 years following the joint BHCC/ Southern Water works.	Human health – properties flooded
39	2009	Rock Street / Rock Grove	Basements in Rock Street/ Rock grove used to flood approximately 10 years ago. Road gulleys blocked and then flooding occurred.	Human health – properties flooded
40	Unknown	A259 Outside Roedean School	Flooding occurred on carriageway on the A259 outside Roedean School approximately 10 years ago. Surface water discharges directly to outfall onto the beach through the groyne. Flooding occurs as outfall fills with pebbles from the beach. It was cleared and outfall rebuilt.	Economic – flooded highway
47	2000	Blatchingham Mill School, Hove	The drains and soakaways at Blatchingham Mill are, at times, unable to cope with the extreme rainfall. The playgrounds tend to slope towards the buildings causing flooding.	Human Health – School flooded

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48	2000	Vardean School (Secondary) Ditchling road	The school sewer system at Vardean School is potentially insufficient at this location. The school drainage system could not cope and inspection chambers blown. This is a PFI School and the provider carried out works.	Human health – flooded school
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Table 4.2 Summary table of historic flooding events outlining consequences.

It is anticipated that the next cycle of the Preliminary Flood Risk Assessment report will be based on more detailed records of flooding events. The Flood and Water Management Act 2010 (FWMA) Section 19 places a duty on a Lead Local Flood Authority (LLFA) to investigate flooding incidents (where appropriate) in the area and publish recorded flooding events. In addition, under section 21 of the FWMA, LLFA also have a duty to maintain a register of structures or features which they consider to have a significant effect on the flood risk in the area. This will potentially highlight future historical flood risk to a greater level of detail for the next PFRA cycle as more details will be recorded by necessity.

## 5 Future Flood Risk

### 5.1 Overview

The Environment Agency (EA) has released a series of national datasets which provide a national overview of flood risk. These datasets include surface water and groundwater flood risk. Currently these are the only data sources with which Brighton and Hove City Council (BHCC) can inform their Preliminary Flood Risk Assessment (PFRA) of Future Flood Risk. Annex 2 of the PFRA spreadsheet shows the future flood risk.

### 5.2 Surface water data

The EA surface water datasets for future flood risk are the Areas Susceptible to Surface Water Flooding (AStSWF) and the Flood Map for Surface Water (FMfSW).

The AStSWF forms the first generation of surface water mapping and identifies the susceptibility to flooding in three bandings: More Susceptible, Intermediate Likelihood and Less Susceptible. The AStSWF assesses the pluvial flood risk based on a 1 in 200 chance rainfall event occurring in any year during a 6.5 hour duration storm. This dataset was used to inform the SWMP and is shown on figure 5.3.

The FMfSW forms the second generation of surface water mapping which is the latest dataset. Notably, the FMfSW takes into consideration infiltration with a reduction of 39% in rural areas and 70% in urban areas. In addition, the FMfSW also takes into account a reduction of 12mm/hr in urban areas to compensate for sewers. (Refer to 'What are the Areas Susceptible to Surface Water Flooding' (EA, 2010)).

The FMfSW has two datasets based on pluvial flooding in a 1 in 30 and 1 in 200 chance rainfall event occurring in any year during a 1.1 hour storm event. The maps display the flood hazard in two depth bandings; greater than 0.1m (Surface water flooding) and greater than 0.3m (Deeper Surface Water Flooding).

The EA has produced the FMfSW to assess the flood risk at a 1 in 30 chance of flooding in any year in order to demonstrate the onset of flooding. 'The 1 in 30 rainfall was used as it is the largest common design standard for urban drainage. Therefore it seeks to capture the 'onset' of flooding in many urban locations'. (Refer to 'What is the Flood Map for Surface Water' (EA, 2010))

Both of the surface water datasets are shown in figure 5.1 and 5.2.

Table 5.1 shows the number of properties and number of people at risk of flooding in Brighton & Hove from the FMfSW and National Receptors Database Property Points.

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FMfSW Depth	Total number of properties at risk of surface water flooding	Number of residential properties at risk of surface water flooding	Number of non-residential properties at risk of surface water flooding	Number of people at risk of surface water flooding. (Human Health consequence)
'Surface Water Flooding' > 0.1m	35,600	31,300	4,300	73,242
'Deeper Surface Water Flooding' > 0.3m	17,400	15,200	2,200	35,568

Table 5.1 Properties at risk of surface water flooding (1 in 200 chance of flooding in any given year) (EA data 'PFRA supporting information', 2011)

### 5.3 Parks and Environmental Sites

The EA provided additional supporting information for the PFRA to determine adverse consequences of flooding. This included data on Parks, World Heritage Sites and Environmental Sites. All flood risk was determined by using the FMfSW. In addition, the flood map was used to exclude coastal flooding and assess the flood risk from surface water only.

There are five parks within Brighton and Hove that are at risk of flooding, which are detailed in table 5.2 below.

Park/ Garden	Percentage at risk of Flooding (%)	Area at risk of Flooding (ha)	Area at risk of flooding in excess of Flood Zone 3 (ha)
The Royal Pavilion, Brighton	55.3	1.36	0.36
Preston Manor and Preston Park	19.1	5.28	5.28
Queen's Park, Brighton	5.9	0.38	0.38
Woodvale Cemetery	0.6	0.14	0.12
Kemp Town Enclosures	0.7	0.06	0.06

Table 5.2 Parks & Gardens at risk of flooding (PFRA update data, EA (March 2011))

There are no World Heritage Sites within the study area but there are a number of environmental sites. The flood risk to Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI) are detailed in table 5.3 below. All sites are located over the boundary between the City of Brighton and Hove and East Sussex County.

Site	Classification	Percentage at risk of flooding (%)	Area at risk of flooding (ha)	Area at risk of flooding in excess of Flood Zone 3 (ha)
Castle Hill	SAC	0	0	0
Brighton to Newhaven Cliffs	SSSI	0.2%	0.4	0.4
Castle Hill	SSSI	0	0	0

Table 5.3 Environmental Sites at risk of flooding (PFRA update data, EA (March 2011))

## 5.4 Groundwater data

The EA groundwater dataset is the Areas Susceptible to Groundwater Flooding (AStGWF) which is shown in figure 5.4. This dataset shows the proportion of each 1km square that is susceptible to potential groundwater emergence and does not indicate that a specific location is susceptible to groundwater flooding.

## 5.5 Locally Agreed Surface Water Information

The surface water flood risk information within Brighton and Hove has been review and discussed at partnership meetings. It is considered that the Surface Water Management Plan and its database of surface water flood risk information reflects the future flood risk from surface water runoff most appropriately. However in comparison of the AStSWF and FMfSW it is considered that the FMfSW most accurately represents the Flood Risk areas in Brighton and Hove as it compensates for infiltration and sewers. Therefore, in accordance with the PFRA guidance the 'locally agreed surface water information' for Brighton and Hove will be the FMfSW.

## 5.6 Climate Change and Long term developments

### 5.6.1 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%.

### 5.6.2 Key Projections for South East 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 18% (very likely to be between 2 and 39%)
- Precipitation on the wettest day in winter up by around 16% (very unlikely to be more than 34%)
- Relative sea level at Portsmouth 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 11 and 24%

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

### 5.6.3 Implications for Flood Risk

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

Wetter winters and more of this rain falling in wet spells may increase river flooding, especially in the rapidly responding catchments draining the South Downs and Weald. 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.

Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

There is a risk of flooding from groundwater in the district. Recharge may increase in wetter winters, or decrease in drier summers.

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.

### 5.6.4 Adapting to Change

Past emissions 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 about 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.

### 5.6.5 Long Term Developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk. In England, Planning Policy Statement 25 (PPS25) 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. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

### 5.6.6 Local Development Framework Sites (LDF)

Local Plan allocated sites and potential Local Development Framework allocated development sites were detailed in the SFRA carried out in 2008. The planning department at BHCC have confirmed that these sites remain unchanged since the publication of the SFRA.

The Development sites are shown on figure 5.1 (Appendix B) with the FMfSW. This indicates which sites are in areas of flood risk according to the Locally Agreed Surface Water Information.

## 5.7 Annex 2

Annex 2 of the Preliminary Assessment Spreadsheet details the significant harmful consequences of future flooding events within the BHCC boundary, which have been considered as part of this PFRA. This identifies the future flooding risk within the BHCC boundary. Future flooding events have been identified through figures 5.1 to 5.5. Adverse consequences have been considered in accordance with chapter 4.4 of this report and by using the National Receptors Database (NRD) shown in figure 5.6. As discussed in chapter 3.3, there are omissions in the NRD, which have reduced the amount of data included in this spreadsheet.

## 6 Flood Risk Areas

### 6.1 Identification of Flood Risk Areas

The Environment Agency (EA) issued the national Indicative Flood Risk Areas (iFRAs) to Lead Local Flood Authorities in December 2010. This identified 10 Flood Risk Areas in England each area having more than 30,000 people at risk of flooding. Brighton and Hove was identified as a national Flood Risk Area. The national iFRAs are shown on figure 6.1 below.

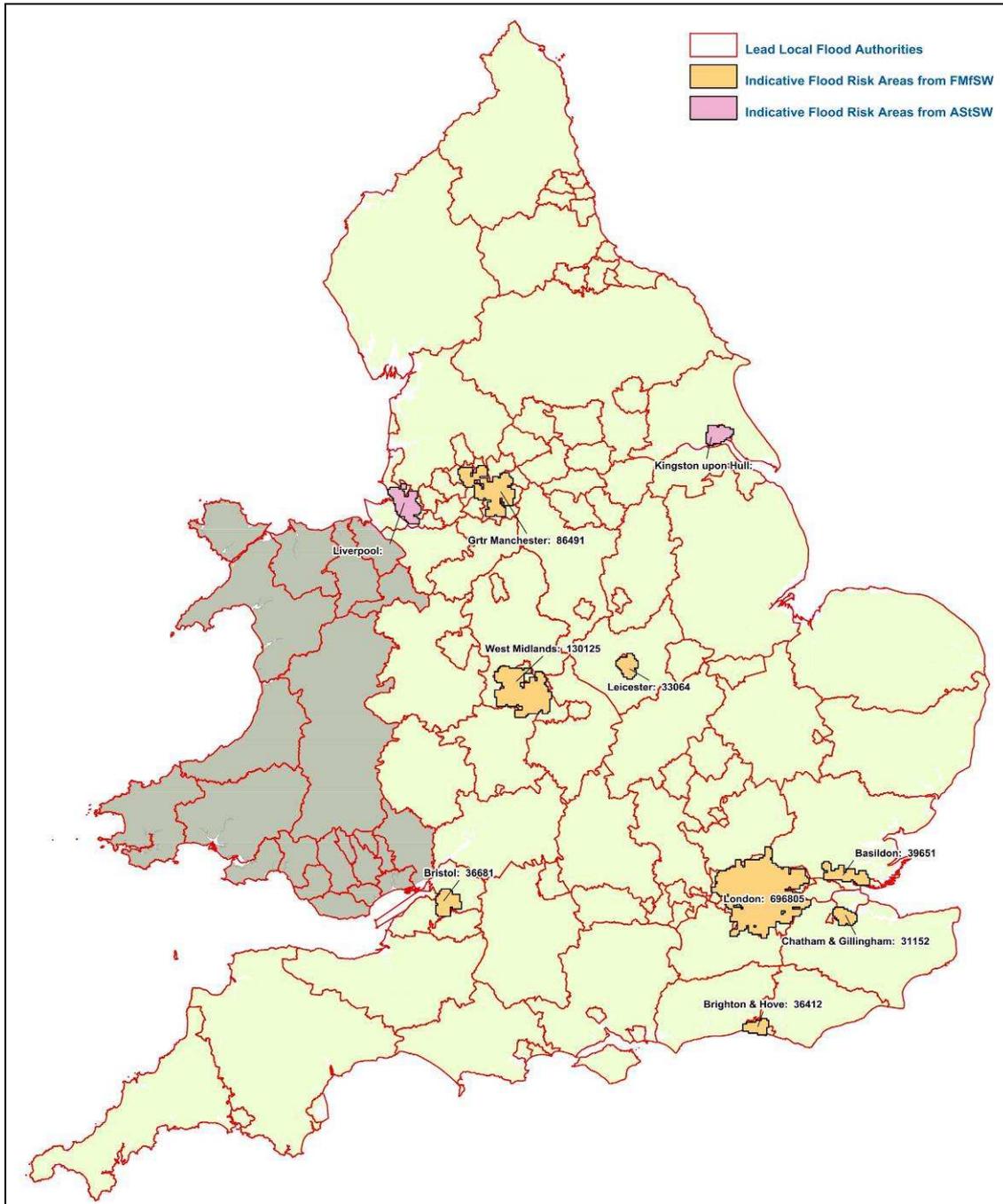


Figure 6.1 Indicative Flood Risk Areas for England (EA drawing IFRA\_EE, 2010)

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The methodology for the Flood Risk Areas was defined by Defra in 'Selecting and reviewing Flood Risk Areas for local sources of flooding' (Defra, 2010) and used by the EA. A grid containing 1km squares was used to divide the country. Each 1 km square was assessed against indicators to establish whether it was above a defined flood risk threshold. The indicators and thresholds were as follows:

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

The Flood Map for Surface Water (FMfSW – deep for 1 in 200 year annual probability rainfall) was used to identify the number of indicators in flood risk areas. All the 1km squares above the Flood Risk Thresholds (as defined above) were identified and informally referred to as 'blue' 1km squares. Where 5 or more 'Places above the Flood Risk Thresholds' (1km blue squares) lie within a 3km square this produces a cluster. Where a cluster, containing one or more 3km squares has more than 30,000 people at risk it is designated as an Indicative Flood Risk Area. Figure 6.2 shows the 'Places above the Flood Risk Thresholds' within the Brighton and Hove City Study area.

From the 'Preliminary Flood Risk assessment for England: Clusters of Places above the Flood Risk Thresholds in England', (EA, 2010), Brighton and Hove is ranked as cluster number 8 in England.

## 6.2 Review of Flood Risk Areas

As discussed in section 4.1, the Environment Agency (EA) has produced indicative Flood Risk Areas (iFRA) which have identified 10 significant flood risk areas within England, of which one covers the Brighton & Hove City area. The Brighton and Hove cluster encompasses an area spreading over 3 administrative areas (and 3 LLFA's); The City of Brighton and Hove, West Sussex County and East Sussex County.

BHCC has decided to amend the iFRA to suit their administrative boundary to the west and east. The EA have confirmed that the Brighton and Hove iFRA can be amended to align to the administrative boundary and the remaining portion of the iFRA will no longer exist. As such West Sussex County Council (WSCC) and East Sussex County Council (ESCC) will assess these areas as part of the iFRA their PFRA but they will no longer be classed as an iFRA.. The decision to split the iFRA with West Sussex was based on a review of the SWMP Phase 1 flood risk overview map (refer to Appendix A drawing 23301/002/001), which shows there are no cross- border flood risk issues and therefore no overriding reasons for combining administrative areas. BHCC also met with WSCC to discuss the blue squares in the iFRA which fall across the border and it was agreed that cross border flooding issues or overland flow paths are not present at this location. As such the number of people that are at risk in Brighton and Hove has been reduced to 33,983 (refer Table 6.1) and WSCC will consider the number of people at risk within the iFRA for their administrative area.

East Sussex similarly confirmed that they were not aware of any cross border issues and on review of the boundary with East Sussex it is noted that the majority of the cluster falls in rural downland areas. From figure 6.2, the flood risk thresholds ('blue squares') predominately do not cross the administrative boundary and where minor areas intersect both unitary regions they fall within rural areas. As such, the flood risk for this area has been captured within the proposed Flood Risk Area.

The decision to amend the iFRA to suit the administrative areas will also ensure all the required deliverables can be carried out in the timescales allocated. However, co-ordination and information sharing will continue between BHCC, WSCC and ESCC.

The amended iFRA encompasses the majority of the city with the exception of the eastern area of Rottingdean. A breakdown of the number of people at risk of flooding is provided in table 6.1 (based

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on the FMfSW 1 in 200 chance of flooding in any given year) The Flood Risk Area GIS layer (in ESRI format) can be found in Appendix E.

LLFA	Number of residential properties at risk of surface water flooding	Number of people (Human health consequence)
The City of Brighton and Hove	14,523	33,983

Table 6.1 LLFA breakdown of Brighton and Hove iFRA

Local flood risk areas will continue to be identified through the BHCC SWMP and Local Strategy for Flood Risk Management (as part of the FWMA requirements).

Annex 3 of the Preliminary Assessment Spreadsheet (Records of Flood Risk areas and their rationale) is included in Appendix B. As discussed in chapter 3.3, there are omissions in the NRD, which have reduced the amount of data included in this spreadsheet.

## 7 Next Steps

### 7.1 Future Data Collection

In accordance with the Preliminary Flood Risk Assessment (PFRA) guidance, all future collection of data that is held by BHCC will be carried out in accordance with the INSPIRE Regulations 2009. These regulations transpose the EU INSPIRE Directive (2007/2/EC) into English law. The directive 'aims to make available consistent spatial data sets about the environment and create services for accessing these datasets' (refer A guide to the INSPIRE Regulations SI 2009 No. 3157, Defra (2009)). The regulations place obligations on Local Authorities who hold more than one spatial dataset. The general principles of INSPIRE are as follows:

1. Data should be collected only once and kept where it can be maintained most effectively.
2. It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.
3. It should be possible for information collected at one level/ scale to be shared with all levels/ scales; detailed for thorough investigations, general for strategic purposes.
4. Geographic information needed for good governance at all levels should be readily and transparently available.
5. It should be easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.

(Reference: PFRA Final guidance, EA (2010) Box 3)

The Annexe 1 spreadsheet for recording past floods shows that some data fields are optional for the first cycle. As previously discussed in chapter 3.4.1, FWMA section 18 places a duty on the Lead Local Flood Authority (LLFA) to investigate flooding incidents and publish recorded flooding events. Hence in order to fulfil the FWMA requirements and the requirements for future cycles of the PFRA, BHCC will be required to record additional information relating to flooding events. Information that is required for the next cycle is shown in table 6.1 below. In addition, Annexe 1 also shows optional data which could be recorded to provide a greater understanding of the past flood events.

BHCC will develop an appropriate spreadsheet for recording the necessary details by their officers.

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Optional for First Cycle	Optional
Start date	Location description
Days duration	Additional sources of flooding
Probability	Confidence in main source of flooding
Main source of flooding	
Main mechanism of flooding	
Main characteristic of flooding	
<b>Significant consequences to human health</b>	
	Human health consequences – number of residential properties
	Property count methods
	Other human health consequences
<b>Significant economic consequences</b>	
	Number of non residential properties flooded
	Property count method
	Other economic consequences
<b>Significant consequences to the environment</b>	
	Environment consequences
<b>Significant consequences to cultural heritage</b>	
	Cultural heritage consequences
	Comments about past flood record
	Data owner
	Flood event outline
	Flood event outline source
	Survey date
	Photo IS
	Lineage
	Sensitive data
	Protective marking descriptor

Table 6.2 Optional data for first cycle and Optional data (Annexe 1)

It is anticipated that there will be considerably more data available on flooding events and flood risk for the next PFRA as a result of the requirements of the FWMA, which places the following requirements upon the LLFA:

- Duty to act consistently with local and national strategies
- Duty to investigate and to maintain a register
- Powers to carry out works to manage flood risk.
- Designation of third party assets
- SuDS approving Body (SAB)

## 7.2 Future Stages of the Flood Risk Regulations (FRR)

The FRR places four main duties upon a LLFA during a six year cycle and dates when they must be reported to the European Commission. The PFRA guidance states when the LLFA should submit these deliverables to the Environment Agency (EA) in order for review, collation, publication and reporting. Figure 7.1 below sets out the FRR deliverables in stages with their timescales for submission to the EA. The first two duties that a LLFA carries out leads to the identification of Flood Risk Areas (if any) and this dictates whether the final two duties must be prepared.

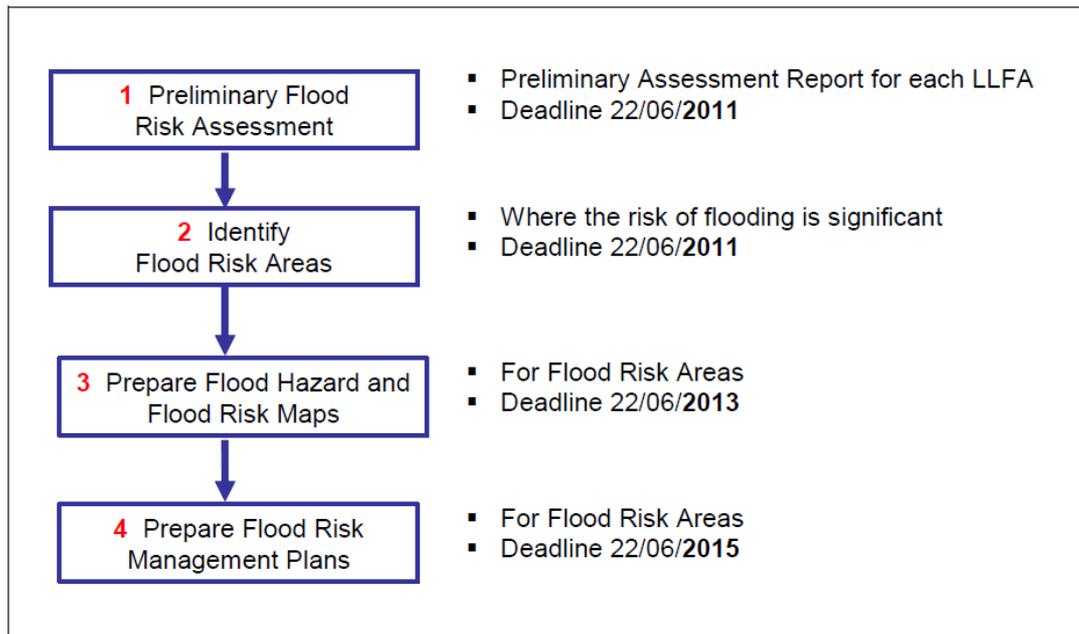


Figure 7.1 Four stages of the Flood Risk Regulations (PFRA Guidance, EA (2010))

Brighton & Hove have identified a Flood Risk Area as part of this PFRA. They are now committed to preparing Flood Hazard and Flood Risk Maps by 2013 and Flood Risk Management Plans by 2015. Guidance from the EA will be provided for these final two stages in due course.

### 7.3 Review process

Prior to submission of this report to the EA, the Preliminary Assessment Report was reviewed and approved by BHCC. As part of the internal review process of the PFRA it is recommended that the PFRA is presented to the Scrutiny Panel. The BHCC PFRA was discussed at a scrutiny workshop on the 22<sup>nd</sup> July 2011.

LGA Alert 16/11 identified that due to local elections in May, LLFAs may not be able to submit the PFRA to the scrutiny panel before the 22<sup>nd</sup> June deadline. As such, BHCC still met the June deadline to submit the PFRA, however the scrutiny process was not carried out prior to this date. Resulting revisions from the scrutiny workshop were submitted to the Environment Agency before the 19<sup>th</sup> August 2011 extended deadline.

Under Section 10 (3) of the FRR the EA are required to review this preliminary assessment report and can recommend modifications. Section 10 (5) of the FRR allows the EA to request submission of this preliminary assessment report by the 22<sup>nd</sup> June 2011.

The EA are required to review, collate and publish all of the PFRAs. The EA will also confirm that the minimum requirements of the EU Directive have been met. This will be carried out by local EA staff and then an EA national review will be carried out to ensure that any amendments to Flood Risk Areas have been justified and are consistent across the country. The PFRA will be recommended to the Regional Flood and Coastal Committees (RFCC) for approval. Following endorsement by the RFCC, the PFRA will be signed-off by the relevant EA Director. The EA are required to publish the Preliminary Assessment reports by the 22<sup>nd</sup> December 2011 (Section 15 FRR).

LLFA are required to review their Preliminary assessment report and flood risk areas before the 22<sup>nd</sup> June 2017 on a 6 year cycle (Section 17 of the FRR).

The PFRA checklist is included in Appendix C, which has been used to review this PFRA.

## 8 References

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## 9 Abbreviations

AStSWF	Areas Susceptible to Surface Water Flooding
AStGWF	Areas Susceptible to Groundwater Flooding
BHCC	Brighton & Hove City Council
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Food and Rural Affairs
DTM	Digital Terrain Model
FMfSW	Flood Map for Surface Water
EA	Environment Agency
ESFRS	East Sussex Fire and Rescue Service
EU	European Union
FCERM	Flood and Coastal Erosion Risk Management
FRR	Flood Risk Regulations 2009
FWMA	Flood and Water Management Act 2010
GHG	Greenhouse Gas
HA	Highways Agency
HADDMS	Highways Agency Drainage Data Management System
HSWGW	Historic Surface Water and Groundwater geodatabase
iFRA	Indicative Flood Risk Area
LDF	Local Development Framework
LiDAR	Light Detection And Ranging
LLFA	Lead Local Flood Authority
NR	Network Rail
NRD	National Receptor Dataset
PBA	Peter Brett Associates LLP
PPS25	Planning and Policy Statement 25: Development and Flood Risk
PFRA	Preliminary Flood Risk Assessment
RFDC	Regional Flood Defence Committee
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SIRF	Sewer Incident Record Form
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SW	Southern Water
SWMP	Surface Water Management Plan
UKCP09	United Kingdom Climate Projections 2009

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## Appendix A

### Figures and drawings

Drawing 2/ Map 8 Preliminary Assessment Map for South East River Basin District

Figure 4.1 Local Information on past floods

Figure 4.2 National information on past floods

Drawing 23301/002/SK001 Historic Flood Events

Figure 5.1 Flood Map for Surface Water 1 in 200 year chance in any year

Figure 5.2 Flood Map for Surface Water 1 in 30 year chance in any year

Figure 5.3 Areas Susceptible to Surface Water Flooding

Figure 5.4. Areas Susceptible to Groundwater Flooding

Figure 5.5 Flood Map

Figure 5.6 National Receptor Database and Environmental Data

Figure 6.2 Places above Flood Risk Threshold

Figure 6.3 Indicative Flood Risk Area

Figure 6.4 Brighton and Hove City Council Indicative Flood Risk Area.

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## Appendix B

**Annex 1 - Records of past floods and their significant consequences (preliminary assessment report spreadsheet)**

**Annex 2 - Records of future floods and their consequences (preliminary assessment report spreadsheet)**

**Annex 3 - Records of Flood Risk Areas and their rationale (preliminary assessment report spreadsheet)**

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## Appendix C

### Annex 4

#### Review checklist

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## Appendix D

### Flood Risk Areas – GIS Layer

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## Appendix E

### Photographs

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