



Reading Borough Council

**Reading Preliminary Flood
Risk Assessment**

Preliminary Assessment Report

Project Ref: 22806/010

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June 2011

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Executive Summary

Peter Brett Associates LLP (PBA) has been appointed by Reading Borough Council (RBC) to prepare the Preliminary Flood Risk Assessment (PFRA) for the Reading Borough area.

The Flood Risk Regulations 2009 (FRR) Part 2 (Section 10) place a duty upon Reading Borough Council as a Lead Local Flood Authority (LLFA) to prepare a Preliminary Flood Risk Assessment by 22nd June 2011.

The Preliminary Flood Risk Assessment aims to provide a high level screening exercise to facilitate flood risk management. The assessment involves the 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. Reading was not listed as a national indicative Flood Risk Area.

As part of the RBC Surface Water Management Plan (SWMP) process, a partnership was set up led by RBC to consider and identify local flood risk. The partnership comprised representatives from the EA, the local water utility company Thames Water Utilities Limited (TWUL) and RBC 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.

Based on the EA's national dataset of surface water flood risk there are 7,600 properties at risk of flooding to a depth greater than 0.3m during a 1 in 200 annual chance rainfall event.

RBC has chosen not to propose a Local Flood Risk Area, but will continue to address local flood risk management through the SWMP process and the 'Local Strategy'.

Local flood risk areas will continue to be identified through the RBC SWMP and Local Strategy for Flood Risk Management (as part of the Flood and Water Management Act 2010 (FWMA) requirements).

1 Introduction

Peter Brett Associates LLP (PBA) has been appointed by Reading Borough Council (RBC) to prepare the Preliminary Flood Risk Assessment (PFRA) for the Reading Borough 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. The report 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 10th 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 Reading Borough 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 22nd June 2011
- Flood hazard maps and flood risk maps Part 3 (Section 19) – by 22nd June 2013
- Flood risk management plans Part 4 (Section 26) – by 22nd 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 Reading PFRA study falls within the Thames River Basin. 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 the EA have already carried out extensive Section 105 modelling and mapping of the Thames. Refer to Appendix A for the Thames 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,

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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

Reading Borough Council unitary authority area incorporates Reading town centre and surrounding areas of Caversham, Tilehurst, Southcote and Whitley, as shown below in figure 1. Reading Borough encompasses an area of approximately 40.4km².

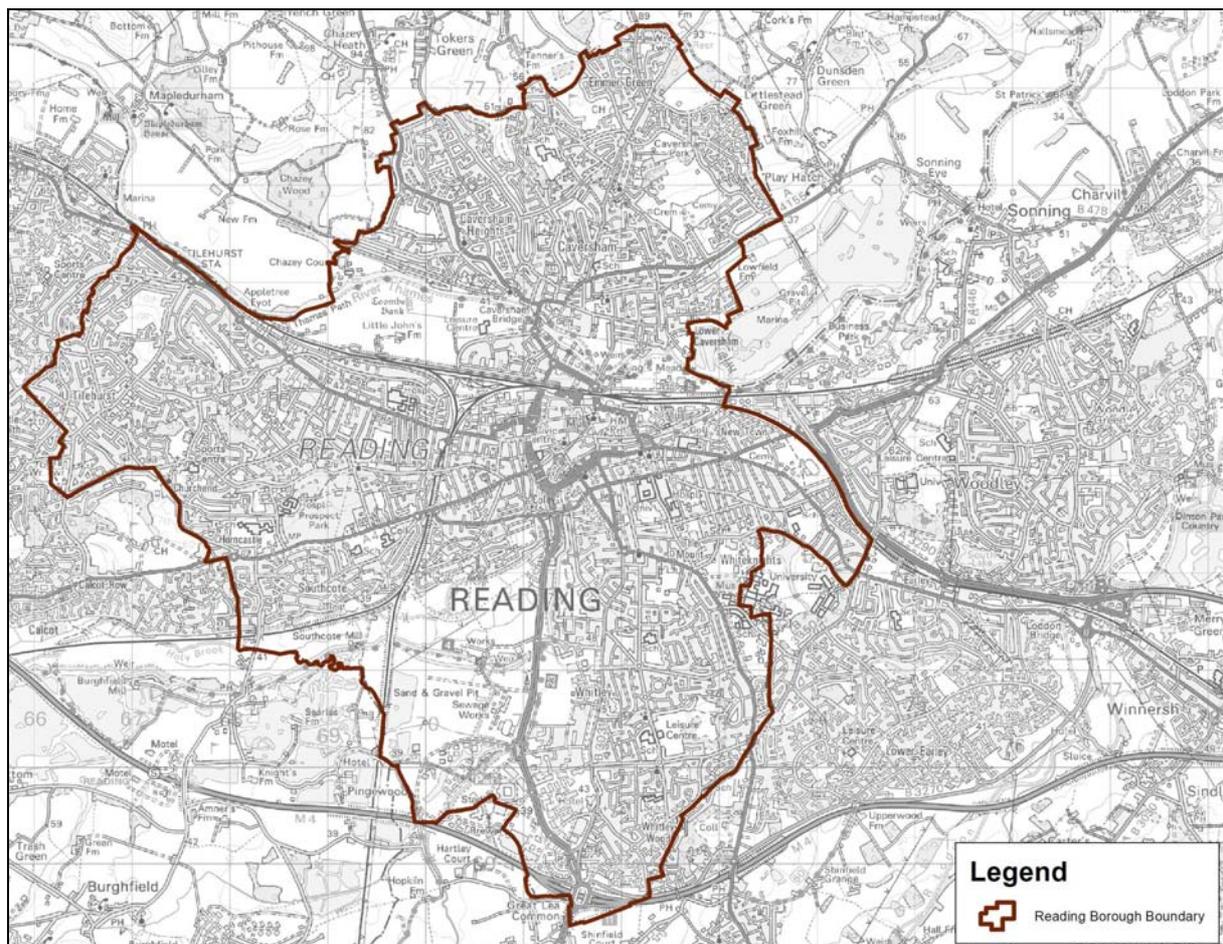


Figure 1 – Reading PFRA Study Area

The study area includes the River Thames, River Kennet, Holy Brook, Foudry Brook, Berry Brook and the Kennet & Avon Canal. All of these watercourses are designated Main River and hence will be dealt with by the Environment Agency. However this PFRA will consider the interaction of the main rivers and canal (designated main river) 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. It is recognised that within the flood zones there will be an increased probability of surface water or groundwater flooding when the watercourses are in flood, as sewer systems become surcharged and the groundwater table rises.

Historically, Reading's most notable flooding event in the last 10 years took place in 2007 when several properties throughout the Borough were internally and externally flooded. This is detailed in chapter 4 of this report.

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. Reading Borough is not one of these 10 areas.

Information from RBC's Surface Water Management Plan (SWMP), which commenced in 2009, 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 RBC PFRA has or will contribute to the same primary objectives as the SWMP which are:

- Collate and map all the existing data relating to flood risk in the borough including flood defence and drainage infrastructure.
- 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.
- 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.
- Work together with stakeholders to agree and prioritise achievable mitigation measures.
- Prepare an implementation plan and programme for delivery of the chosen solutions, identifying relevant partner and stakeholder contributions.
- Commit to review and monitor the effectiveness of implemented solutions.

Prior to the SWMP, RBC produced a Strategic Flood Risk Assessment (SFRA) in 2007. 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), Reading Borough Council (RBC) is responsible for managing local flood risk and under the Flood Risk Regulations 2009 (FRR), Reading is required to produce the following deliverables:

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

This preliminary assessment report forms part of the Preliminary Flood Risk Assessment (PFRA).

The 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 FRR and 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 RBC to consider and identify local flood risk. The partnership comprised representatives from the EA, the local water utility company Thames Water Utilities Limited (TWUL) and RBC 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 Royal Berkshire Fire & Rescue Service, Network Rail, British Waterways and Jacobs Engineering, who produced the Strategic Flood Risk Assessment (SFRA) on behalf of RBC.

In addition, the partnership also worked with Wokingham Borough Council to identify any cross boundary issues present within the 'Greater Reading Area'. The 'Greater Reading Area' includes Woodley, Earley and Sonning (within the Wokingham Borough). Wokingham carried out a 'Greater Reading Area' Phase 1 SWMP report which did not highlight any significant flood risk areas on the boundary with RBC.

To date the RBC SWMP has not included public consultation or communication, 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.

RBC has historically carried out community liaison and engagement prior to and following major flood events, which includes:

- RBC's Emergency Planning Office issued flood warning notices of heavy rainfall events, as received from EA/ MET Office via radio, Council website and newspapers.
- Public meetings were held jointly between RBC and Thames Water after the 2007 flooding.
- Following the 2007, the Emergency Planning team visited every affected property to gather information on flooding.

(Reference: RBC Consultations, RBC (2009))

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 Reading Borough Council (RBC)

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

- a) Flooded properties – This included internal flooding, external flooding, flooded schools and other RBC buildings from the 2007 event.
- b) Housing information – This information detailed the location of gullies within the extents of RBC owned housing land.
- c) Flood records- Historical flood extents were provided for 2000, 2002 and 2003.
- d) Control sites of major gas storage, critical highway corridors, key crossing points, lifelines, schools, barracks and chalk mines were highlighted. Blocked grills were also shown.
- e) Complaints - Complaints that were reported to RBC in relation to flooding were provided. This included park areas as well as general flood complaints.
- f) RBC Strategic Flood Risk Assessment (SFRA) – 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 SFA was acquired which included groundwater flooding, highway flooding, sewer flooding, flood history and flood risk.
- g) RBC Local Development Framework (LDF) – The 'Sites and Detailed Policies Document, Pre-Submission Draft' was used to identify the LDF sites within the Borough.

3.2.2 Thames Water Utilities Limited (TWUL)

All Thames Water asset records for surface water were provided for use in the SWMP subject to completion of a confidentiality agreement. In addition, the DG5 register for Reading was provided indicating areas of historic sewer flooding. This has not been shown on SWMP or PFRA drawings for confidentiality reasons. However it has been used to substantiate other flood record incidents.

3.2.3 Environment Agency (EA)

Through the SWMP partnership, the following data was provided from the EA's national datasets:

- a) LiDAR data –Light Detection And Ranging data, which provides detailed elevation data to map terrain. However, the dataset for Reading Borough was incomplete and so additional areas of Digital Terrain Model (DTM) were purchased from a commercial distributor.
- b) Flood defence – Formal and non formal flood defence structures.
- c) Flood Map – Flood Zones show the extent of flooding from rivers for different probabilities.
- d) Source Protection zones (SPZ) – Show the risk of contamination to groundwater sources.

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- e) Maps of Areas Susceptible to Surface Water Flooding (AStSWF)

Additional data was release by the EA in accordance with PFRA requirements via their Geostore website and was added to the database:

- f) Maps of Areas Susceptible to Groundwater Flooding (AStGWF)
- g) Maps of Areas Susceptible to Surface Water Flooding (updated) (AStSWF)
- h) Detailed River Network – shows fully attributed river centrelines
- i) Flood Map (revised) – as per item (c)
- j) Flood Map for Surface Water (FMfSW) 1 in 30 yr chance of flooding in any year
- k) Flood map for Surface Water (FMfSW) 1 in 200 yr chance of flooding in any year
- l) Historic Flood Map- shows the combined extents of flooding from rivers and groundwater.
- m) Historic Landfill – shows sites where there is no PPC permit or waste management licence currently in force.
- n) Main River – shows location of EA Main Rivers
- o) 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 all historic surface water flooding data, Environmental sites, Parks and World Heritage sites. Notably, the Reading study area has no environmental or world heritage sites. The parks data has been presented with the National Receptors database for the purposes of this PFRA (see figure 5.6). In addition, historic surface water flooding data held by the EA was provided.

3.2.4 Network Rail (NR)

PBA requested all Network Rail track drainage records in Reading Borough. Part of this data was received, which covers a drainage investigation for the Reading Station redevelopment area. However no other information on the Network Rail drainage assets was provided.

3.2.5 Royal Berkshire Fire & Rescue Service (RBFRS)

PBA requested all Fire Brigade records for flooding within the last ten years. The RBFRS provided flooding events for the Berkshire area which was subsequently sorted for the Reading area only.

3.2.6 British Waterways (BW)

British Waterways provided data on the location of all BW canal channels, locks, sluices and weirs as well as records of overtopping and breach events on the network.

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).

<u>Consequence</u>	<u>Indicator</u>
Human health	<ol style="list-style-type: none"> 1. Number of people * 2. Number of critical services
Social and Economic activity	<ol style="list-style-type: none"> 1. Number of non-residential properties 2. Infrastructure network 3. Area of agricultural land
Environment	<ol style="list-style-type: none"> 1. Consequence of pollution 2. Impact on internationally and nationally designated environmental sites 3. Impact on internationally and nationally designated heritage assets.
Cultural Heritage	<ol style="list-style-type: none"> 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 Dataset (NRD), which details critical infrastructure such as schools, electricity substations, hospitals etc. In addition, the NRD also details building types which allows property counts to be undertaken for different building types. 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. It should be noted that the RBC 'flooded properties' records denote properties which were flooded during the July 2007 storm event only. Records were collated through a 'door knocking' survey of housing in known problem areas. There is limited data available to the extent of flooding of each property – either external or internal flooded properties are noted, with no details on extent or depth of flooding. The extent of the flooding may have not been accurately recorded as residents may not have reported flooding incidents due to concerns regarding insurance and saleability of property. Whilst the survey appears to cover a large area of Reading it is not clear on the extents of this survey or methodology.

Network Rail was unable to provide detailed track drainage for the entirety of the network within the Study area as part of the SWMP process. Fire Brigade 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.

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. As part of the SWMP Phase 2 risk assessment, a numerical weighting was applied to risk areas depending upon the flood risk data type and data source (and hence quality) to rank local flood risk areas. The SWMP guidance provides the following information on data quality.

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 RBC 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
RBC	3	Not invented but based on experience and judgement – No detailed information provided.
Thames Water Utilities Limited	2	Data with known deficiencies
EA	1	Best possible
Network Rail	4	Heroic assumptions - Limited data received.
RBFRS	3	Not invented but based on experience and judgement - Full description of events not included.
British Waterways	2	Data with known deficiencies

Table 3.3 Data quality of RBC 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. All future data collection (via the process described in chapter 7.1) will be added to this existing database. It is anticipated that a higher level of detail will be recorded in the future in accordance with PFRA requirements (refer Chapter 7).

3.4.3 Data security

PBA have signed a confidentiality agreement with TWUL to acquire and use information on their drainage assets and DG5 flood register for the SWMP and PFRA.

EA data was released to PBA as part of the SWMP partnership agreement. Additional EA data was sourced by RBC from the EA Geostore website. RBC is licensed by the EA to use this data for the preparation of their PFRA.

British Waterways supplied their data set in accordance with their end user agreement. This requires all data to remain confidential and is not to be passed onto third parties unless required to do so by law.

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 Reading Borough area. Historical flood records are illustrated on figure 4.1 and figure 4.2 (refer Appendix A).

There are several documents which have aimed to identify past flooding within Reading Borough. A Strategic Flood Risk Assessment (SFRA) was carried out in 2007 which 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 Thames Catchment Flood Management Plan (CFMP) summary was issued by the EA in December 2009. The Surface Water Management Plan (SWMP), as previously discussed, is the latest assessment of flood risk aiming to understand and resolve local flooding.

4.2 Local information about past floods

4.2.1 DG5 register – Sewer Flooding

The DG5 register from Thames Water shows the location and date of historic flooding on the surface water network within Reading. The DG5 register was used with the SWMP Phase 1 database to confirm potential flood risk areas. The Thames Water confidentiality agreement requires that individual locations are not shown on public plans.

4.2.2 Reading Borough Council (RBC) Records

The limited flooding records RBC hold include the following datasets:

- 2007 flood event – Internally and externally flooded residential buildings.
- 2007 flood event – Flooded Schools
- 2007 flood event – RBC buildings
- Complaints reported to RBC from members of the public.

The majority of the flood records above contain limited details on the effects of flooding. The 2007 flood event records for residential properties list the address of the property, but do not record detail such as depth, source, and duration. The 2007 flood event records for schools and RBC buildings provide a basic description but again do not include specific details.

Whilst the consequences of these past floods are not recorded, the 2007 event had significant harmful consequences to certain areas of Reading where internal flooding occurred. This is graphically depicted by a number of photographs of the 2007 events which were collected as an evidence base for a 'Property Level Protection' funding bid to Defra (refer to Appendix D).

4.2.3 Royal Berkshire Fire & Rescue Service (RBFRS) Records

The RBFRS provided all flooding event data for the last 10 years which was sorted to include only events in Reading and 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 18 records of flooding events over the 10 year period. For the majority of the records there is no consequence stated and so for these records it is considered that there were no significant consequences. As per the Preliminary Flood Risk Assessment (PFRA) guidance these records will not be included in the preliminary

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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 Jacobs Engineering on behalf of RBC in 2007, data collection of historical flooding was carried out. This included flooding issues from surface water, groundwater and sewer flooding collated from RBC and the Environment Agency (EA). 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.

4.2.5 Anecdotal records

The SWMP partnership reviewed anecdotal comments that were made concerning flood risk areas in Lower Caversham, in particular Amersham Road and the area surrounding it. The SWMP Phase 1 report, PBA (2010), states that “the Environment Agency verbally indicated that their records show that 4 properties were recorded as affected by flooding in the Lower Caversham area during the 2003 event. However, modelling and EA flood records show that there was extensive flooding in Lower Caversham and more specifically Amersham Road.

Reading Borough Council confirmed that their property holdings located in the Amersham Road development were constructed with threshold levels above the predicted fluvial flood level. Hence there was limited flooding of properties during the event, yet highways were known to have flooded. PBA have visually inspected aerial photographs at the EA which confirm that the highway infrastructure suffered flooding during the 2003 event.

There are also several accounts of highway drainage and surface water sewer flooding in the Gosbrook Road and Amersham Road area in Caversham, Reading.

All local information on past floods is shown on figure 4.1 (refer Appendix A).

4.3 National information about past floods

The EA Historic Flood map was obtained for the Reading area. This shows the flood extent from records of flooding from rivers and groundwater only. This can be seen in figure 4.2 (refer Appendix A). Part of this relates to Main River, which can be excluded from this PFRA as it is the responsibility of the EA. The EA has confirmed that it has no records of groundwater flooding for the Reading area and hence it is assumed that the EA Historic Flood map relates to River flooding only. 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.

Historic surface water flooding data was provided by the EA for use within the PFRA. This data comprised 25 flooding events in the Borough dating back to 1947, which was reduced to 5 incidents within the last 10 years (6th January 2003 and 6th December 2000). This data is shown on figure 4.2 (refer to Appendix A).

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. Flooding incidents which relate to the same event have been grouped together for clarity. 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.

July 2007 saw the wettest summer since records began and Reading experienced flooding throughout the Borough. Whilst there have been a number of other flooding events, for the purpose of this PFRA it was decided that only the 2007 event was on a European scale of 'significant' consequence. Hence, whilst other events are included within Annex 1, no significant consequences are identified. All consequences of known events have been detailed in chapter 4.6 of this report. 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

As discussed above some data has insufficient information to establish the consequences of the flooding events, however there is some limited available information which is shown in table 4.2 below. It has been assumed that for instances listed in table 4.2 have a significant consequence.

Flood Event	Flood Date	Location	Data Source	Description	Consequences
1. July 2007 Storm event	July 2007	Various throughout Reading	RBC/ RBFRS	Flooding through the Reading Area. Internally flooded residential properties at 139 addresses.	Human Health - 325 people affected by internally flooded ¹
2. January 2002	03/01/2002	Coley, Reading	RBFRS	Children stranded in flood plain	Human Health – 5 people
3. January 2002	03/01/2002	Millers Court, Causeway. Caversham	RBFRS	Flooding in Road	Infrastructure ²
4.	05/01/2002	Amersham Road, Lower Caversham	RBFRS	2 Occupants of car stranded in flood water	Human Health – 2 people
5.	07/11/2000	Kiln Road, Emmer Green	RBFRS	1 Occupant of car stranded in flood water	Human Health – 1 person
6.	26/05/2000	Roundabout M4, Junction 11 Whitley Wood	RBFRS	Flooding in Road	Infrastructure
7.	09/08/1999	Callington Road, Whitley	RBFRS	Flooding in Road	Infrastructure
8.	05/01/1998	Worton Drive	RBC	Blocked ditch caused office unit to flood	Economic – one non residential property
9.	23/12/2002-12/01/2003	Sewerage Works, Rose Kiln Lane	EA	Flooding within ground of sewerage works	Environmental

Table 4.2 Summary table outlining consequences.

¹ Assumes 2.34 people per household as per PFRA guidance. ² Denotes non – critical infrastructure.

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 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 Reading Borough Council (RBC) 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 Environment Agency (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 (refer Appendix A).

Table 5.1 shows the number of properties and number of people at risk of flooding in Reading from the FMfSW.

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	22,700	19,700	3,000	46,098
'Deeper Surface Water Flooding' > 0.3m	7,600	6,500	1,100	15,210

Table 5.1 Properties at risk of surface water flooding (1 in 200 chance of flooding in any given year)

5.3 Groundwater data

The EA groundwater dataset is the Areas Susceptible to Groundwater Flooding (AStGWF) which is shown in figure 5.4 (Appendix A). 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.

5.4 Locally Agreed Surface Water Information

The surface water flood risk information within Reading has been reviewed and discussed at partnership meetings. RBC consider 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. This is shown in drawing 22806/001/001/Rev B (Appendix A). However in comparison of the AStSWF and FMfSW it is considered that the FMfSW 1 in 200 year chance of flooding in any year most accurately represents the Flood Risk areas in Reading as it compensates for infiltration and sewers (refer to Figure 5.1 Appendix A). The 1 in 200 year chance of flooding in any year has been chosen as it relates to a more significant potential event than that of the 1 in 30 year. Therefore, in accordance with the PFRA guidance the 'locally agreed surface water information' for Reading will be the FMfSW.

5.5 Climate Change and Long term developments

5.5.1 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%.

5.5.2 Key Projections for Thames 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 15% (very likely to be between 2 and 32%).
- Precipitation on the wettest day in winter up by around 15% (very unlikely to be more than 31%).
- Relative sea level at Sheerness 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 8 and 18%.

5.5.3 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 in both rural and heavily urbanised catchments. 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-bearing chalk and limestone aquifers across 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.

5.5.4 Adapting to Change

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

Although the broad climate change picture is clear, we have to make local decisions 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.

5.5.5 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

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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).

5.5.6 Local Development Framework Sites (LDF)

The RBC LDF comprises a series of planning policy documents, which includes the Sites and Detailed Policies Document (SDPD). The SDPD itself was originally two documents; the Development Management Document (DMD) and the Site Allocations Document (SAD). These help to achieve the policies and spatial strategy of Reading's Core Strategy.

The SDPD shows proposed development areas within Reading. The SDPD identifies sites and areas that were originally consulted upon in October 2008 as part of the SAD.

The SDPD and its accompanying 'Proposals Map' are currently in a revised Pre-submission draft form. Consultation for these is currently being undertaken at the time of this report being written. The consultation period takes place from the 21st February to 4th April 2011. For the purposes of this document it is assumed that the sites stated within the SDPD are fixed. This will be verified at the next PFRA cycle.

Table 2 below summarises the proposed LDF sites and identifies those which are located within an area of flood risk (as defined by the Locally Agreed Surface Water Information - FMfSW).

<u>Proposed LDF Site</u>	<u>Area of Flood Risk</u> <u>(as defined by Locally Agreed Surface</u> <u>Water Information)</u>
South Reading Strategic Development Sites	
SA2: Worton Grange	Yes
SA2b: Berkshire Brewery	Yes
SA2c Land to North of Manor Farm Road	Yes
Other Sites for Development and Change	
SA4: Dee Park	Yes
SA5: Park Lane Primary School, The Laurels and Downing Road	Yes
SA6: Whiteknights Campus, University of Reading	Yes
SA7: Crescent Road Campus	Yes
Other Sites for Housing Development	

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SA8a: Land at Kentwood Hill	No
SA8b: 784-794 Oxford Road	No
SA8c: Alice Burrows Home, Dwyer Road	Yes
SA8d: Rear of 303-315 Oxford Road	Yes
SA8e: Dellwood Hospital, Liebenrood Road	Yes
SA8f: Bath Reservoir, Bath Road	Yes
SA8g: Part of Former Battle Hospital, Portman Road	Yes
SA8h: Land adjacent to 40 Redlands Road	No
SA8i: Land at Lowfield Road	No
SA8j: Napier Court, Napier Road	No
SA9a: 211-221 Oxford Road, 10 & rear of 8 Prospect Street.	Yes
SA9b: Elvian School, Bath Road	Yes
SA9c: 261-275 London Road	Yes

Table 6.1: Proposed Development Sites (Site and Detailed Policies document, Revised Pre-Submission Draft. Development Plan Document, RBC February 2011)

5.6 Annex 2

Annex 2 of the Preliminary Assessment Spreadsheet details the significant harmful consequences of future flooding events which have been considered as part of this PFRA. Future flooding events have been identified through figures 5.1 to 5.5 (refer to Appendix A). Adverse consequences have been considered in accordance with chapter 4.4 of this report and by using the National receptors database shown in figure 5.6.

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 (LLFAs) in December 2010. This identified 10 Flood Risk Areas in England each area having more than 30,000 people at risk of flooding. Reading was not listed as a national Flood Risk Area.

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. Figure 6.1 shows the 'Places above the Flood Risk Thresholds' within the Reading Study area.

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.

From the 'Preliminary Flood Risk assessment for England: Clusters of Places above the Flood Risk Thresholds in England', (EA, 2010), Reading is ranked as cluster number 14 in England.

6.2 Review of Flood Risk Areas

As discussed in section 4.1, Reading is not identified as an indicative Flood Risk Areas for England and RBC agrees with the decision for the cluster to not be included as a national Indicative Flood Risk Area. Local flood risk 'hotspots' have been identified within the study area as part of the Surface Water Management Plan (SWMP), Phase 2 (Risk Assessment).

Local flood risk areas will continue to be identified through the Reading Borough Council (RBC) SWMP and Local Strategy for Flood Risk Management (as part of the Flood and Water Management Act 2010 (FWMA) requirements).

As the Reading Preliminary Flood Risk Assessment (PFRA) has not been identified as a Flood Risk Area, Annex 3 of the Preliminary Assessment Spreadsheet has been omitted from this PFRA.

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 Reading Borough Council (RBC) 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, Flood and Water Management Act 2010 (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, RBC 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.

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

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<u>Optional for First Cycle</u>	<u>Optional</u>
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	
<i>Significant consequences to human health</i>	
	Human health consequences – number of residential properties
	Property count methods
	Other human health consequences
<i>Significant economic consequences</i>	
	Number of non residential properties flooded
	Property count method
	Other economic consequences
<i>Significant consequences to the environment</i>	
	Environment consequences
<i>Significant consequences to cultural heritage</i>	
	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 Preliminary Flood Risk Assessment (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 Review process

Prior to submission of this report to the EA, the Preliminary Assessment Report was reviewed and approved by the lead member from RBC. As part of the internal review process of the PFRA it is recommended that the PFRA is presented to the Scrutiny Panel. 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 22nd June deadline. As such, RBC will still meet the June deadline to submit the PFRA, however the scrutiny process will not have been carried out prior to this date. Any resulting revisions from the scrutiny panel will be submitted to the Environment Agency as soon as possible but no later than the extended deadline of 19th August 2011.

Under Section 10 (3) of the Flood Risk Regulations 2009 (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 22nd 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 Defence Committee (RFDC) for approval. Following endorsement by the RFDC, the PFRA will be signed-off by the relevant EA Director. The EA are required to publish the Preliminary Assessment reports by the 22nd December 2011 (Section 15 FRR).

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

The PFRA checklist is included in Annex 4, 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
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Food and Rural Affairs
DMD	Development Management Document
DTM	Digital Terrain Model
FMfSW	Flood Map for Surface Water
EA	Environment Agency
EU	European Union
FCERM	Flood and Coastal Erosion Risk Management
FRR	Flood Risk Regulations 2009
FWMA	Flood and Water Management Act 2010
LDF	Local Development Framework
LIDAR	Light Detection And Ranging
LLFA	Lead Local Flood Authority
NRD	National Receptor Dataset
PBA	Peter Brett Associates LLP
PPS25	Planning and Policy Statement 25: Development and Flood Risk
PFRA	Preliminary Flood Risk Assessment
RBC	Reading Borough Council
RBFRS	Royal Berkshire Fire & Rescue Service
RFDC	Regional Flood Defence Committee
SDPA	Sites and Detailed Policies Document
SFRA	Strategic Flood Risk Assessment
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TAN15	Technical Advice Note 15
TWUL	Thames Water Utilities Limited
UKCP09	United Kingdom Climate Projections 2009

Appendix A

Figures and drawings

Drawing 2/ Map 10 Preliminary Assessment Map for Thames River Basin District

Figure 4.1 Local Information on past floods

Figure 4.2 National information on past floods

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 Data

Drawing 22806/001/001 Rev B Surface Water Management Plan: Strategic Level Overview

Figure 6.1 Places above Flood Risk Threshold

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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) – NOT USED

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Appendix C

Annex 4

Review checklist

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Appendix D

Photographs

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July 2007 Flooding



A33



Blandford Road



Harness Close



Harness Close



Northumberland Avenue