

# Leicester Preliminary Flood Risk Assessment Update

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Leicester City Council

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## Quality information

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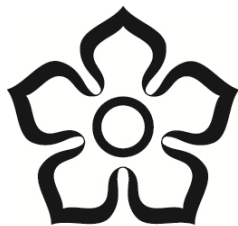
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<b>Abbreviation</b>	<b>Definition</b>
<b>BUAs</b>	<b>Built-up areas</b>
<b>BUASDs</b>	<b>Built-up area sub-divisions</b>
<b>EA</b>	<b>Environment Agency</b>
<b>FWMA</b>	<b>Flood and Water Management Act</b>
<b>IFRMS</b>	<b>Integrated Flood Risk Management Strategy</b>
<b>LA</b>	<b>Local Authorities</b>
<b>LCC</b>	<b>Leicester City Council</b>
<b>LPA</b>	<b>Local Planning Authority</b>
<b>NPPF PPG</b>	<b>National Planning Policy Framework, Planning Practice Guidance</b>
<b>PFRA</b>	<b>Preliminary Flood Risk Assessment</b>
<b>PUA</b>	<b>Principle Urban Area</b>
<b>SAB</b>	<b>SuDS Approving Body</b>
<b>SFRA</b>	<b>Strategic Flood Risk Assessment</b>
<b>sMDAs</b>	<b>strategic Major Development Areas</b>
<b>SuDS</b>	<b>Sustainable Drainage Systems</b>
<b>SWMP</b>	<b>Surface Water Management Plan</b>
<b>uFMfSW</b>	<b>updated Flood Map for Surface Water</b>

# 1. Introduction

## 1.1 What is a Preliminary Flood Risk Assessment?

This document forms a Preliminary Flood Risk Assessment (PFRA) report for Leicester City Council (LCC) as required in accordance with the Flood Risk Regulations 2009. These Regulations implement the EU Floods Directive to the United Kingdom and provide a framework for managing flood risks over a 6 year cycle.

A PFRA is a high level screening exercise to identify areas of significant flood risk within a given study area. The PFRA involves collecting information on past (historical) and future (potential) floods, assembling the information into a report with supplemental appendices identifying flood risk areas. In 2011, each LLFA completed a PFRA and identified Flood Risk Areas for local flood risk; primarily surface water runoff, groundwater and ordinary watercourses. These PFRAs, including that produced for Leicester City, were submitted to the Environment Agency and issued to the EU.

In January 2017, the Environment Agency and Defra produced new guidance<sup>1</sup> on the criteria for assessment of significant flood risk which reflects improved national information on surface water flood risk. In accordance with this guidance, a review of new indicative Flood Risk Areas must be completed as part of a PFRA Review and submitted to the Environment Agency before 22<sup>nd</sup> June 2017.

This report has been prepared for Leicester City Council and provides an update to that the report produced in 2011 in accordance with the January 2017 guidance. It provides a high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding. The development of new information is not required, but new analysis on existing information may be needed.

This PFRA has therefore been based on existing and readily available information and brings together information from a number of available sources such as the Environment Agency's nationally published information (for example their updated Flood Map for Surface Water (uFMfSW)) and existing channels of reporting such as Strategic Flood Risk Assessments (SFRA), Surface Water Management Plans (SWMPs) and Local Flood Risk Management Strategies (LFRMS).

## 1.2 Background

The key drivers behind the PFRA are two pieces of legislation; (i) the Flood Risk Regulations 2009 (The Regulations) and (ii) the Flood and Water Management Act (FWMA). The Regulations were created to transpose the EC Floods Directive (Directive 2007/60/EC) into domestic law in England and Wales. The Floods Directive provides a framework to assess and manage flood risks in order to reduce adverse consequences for human health, the environment (including cultural heritage) and economic activity.

The FWMA makes specific provision for the recommendations provided by Sir Michael Pitt in his independent review of the flooding experienced across much of England and Wales in 2007.

Under these pieces of legislation, all upper tier local authorities are designated 'Lead Local Flood Authorities' (LLFA) and have formally been allocated a number of key responsibilities with respect to local flood risk management. Consequently, Leicester City Council is designated as a LLFA. A full description of these responsibilities is provided in Section 2.

The Regulations place duties on the Environment Agency and Lead Local Flood Authorities (LLFAs) to prepare a number of documents including:

- Preliminary Flood Risk Assessments;
- Identification of areas of potential significant risk, referred to as flood risk areas

<sup>1</sup> Environment Agency/Defra. 25<sup>th</sup> January 2017. Review of preliminary flood risk assessments (Flood Risk Regulations 2009): guidance for lead local flood authorities in England.

- Flood hazard and flood risk maps;
- Flood Risk Management Plans (FRMPs) setting out measures and actions to reduce the risk.

The purpose of a PFRA report under the Regulations is to provide the evidence for identifying nationally significant Flood Risk Areas. The report will also provide a useful reference point for all local flood risk management and inform local flood risk management strategies.

The scope of a PFRA is to consider past flooding and potential future flooding from sources of flooding other than main rivers, the sea and reservoirs (these fall under the responsibility of the Environment Agency). Therefore, the PFRA should address flooding from surface runoff, groundwater and ordinary watercourses and any interaction these have with local drainage systems.

A PFRA should also consider floods which have significant harmful consequences for human health, economic activity and the environment, where this information is available.

### 1.3 Preliminary Flood Risk Assessment Update Timetable

Table 1-1 shows the elements of work required from LCC under the Regulations, along with the timescales for their delivery in accordance with the new guidance<sup>1</sup>.

**Table 1-1: Timetable for the first review of Preliminary Flood Risk Assessment reports and FRAs**

	LLFAs to complete and submit reviews to the Environment Agency	Environment Agency to review LLFA submissions
<b>Preliminary assessment report</b>	By 22 June 2017	By 22 December 2017
<b>Identification of FRAs</b>	By 22 June 2017	By 22 December 2017

### 1.4 Aims and Objections

The key objectives of the PFRA Update can be summarised as follows:

- Summarise the methodology adopted for the PFRA Update with respect to data sources, availability and review procedures;
- Establish an evidence base of historic flood risk information, which will be built on in the future and used to support any update to Leicester's LFRMS<sup>2</sup>;
- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and ordinary watercourses), and the consequences and impacts of these events;
- Assess the potential harmful consequences of future flood events within the study area;
- Review the current national assessment of indicative Flood Risk Areas (FRAs) provided by the Environment Agency and provide explanation and justification for any amendments required to the FRAs;
- Provide a summary of the systems used for data sharing and storing, and provision for quality assurance, security and data licensing arrangements,
- Identify relevant partner organisations involved in future assessment of flood risk; and summarise means of future and ongoing stakeholder engagement; and
- Describe arrangements for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information.

<sup>2</sup> Leicester City Council: Local Flood Risk Management Strategy (LFRMS). Available at: <https://www.leicester.gov.uk/media/178225/master-lfrms-web-lo-res-mar-2015.pdf>

## 1.5 Study Areas

The administrative area of Leicester City covers an area of 71 km<sup>2</sup>. The study area is heavily urbanised and this urban nature has resulted in a number of watercourses being culverted, straightened and retained by formal engineered structures. There is also a high level of interaction between the surface water sewer system and watercourses.

The administrative area of LCC has a population of 329,839 (ONS 2011)<sup>3</sup>. Leicester has a diverse multicultural population with over 70 languages spoken in the city.

The city is underlain by a mixed solid geology of the Upper Triassic period consisting of various sedimentary deposits including Rhaetic Beds, Keuper Marls and Sandstones. These are overlain by a drift geology consisting of moderately permeable soils which can act to impede infiltration leading to up to 40% of rainfall running off (EA, River Trent CFMP 2010)<sup>4</sup>.

The topography on which the city lies is quite flat either side of the wide River Soar valley, but rises to the west towards Charnwood Forest, and to the east. The River Soar flows from south to north through the city, before eventually joining the River Trent at Trent Lock. The Grand Union Canal is also situated in the city and is interlinked with the navigable reaches of the River Soar. There are numerous watercourses within the Leicester City administrative boundary some of which are designated as Main Rivers and others as Ordinary Watercourses.

The Environment Agency has discretionary flood risk management and enforcement powers of Main Rivers. In Leicester City these include the River Soar, and its tributaries as follows:

- Saffron Brook,
- Braunstone Brook,
- Willow Brook (including its own Main River tributaries Evington Brook, Thurnby Brook, Bushby Brook, Scraftoft Brook), and
- Melton Brook.

LCC have responsibilities for ordinary watercourses, many of which are culverted and artificially straightened. The key ordinary watercourses that the Council investigated as part of the 2012 SWMP<sup>5</sup> include:

- Hol Brook,
- Queens Road Brook,
- Portwey Brook,
- Gilroes Brook,
- Wash Brook,
- Thurmaston Parish Dyke,
- Ethel Brook, and
- Western Park Brook

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<sup>3</sup> Office for National Statistics (ONS). Accessed on 20/04/2017 at:  
<http://www.neighbourhood.statistics.gov.uk/dissemination/LeadTableView.do?a=7&b=6275151&c=Leicester&d=13&e=61&q=6383957&i=1001x1003x1032x1004&m=0&r=1&s=1492700346275&enc=1&dsFamilyId=2491>

<sup>4</sup> Environment Agency, River Trent Catchment Flood Management Plan. Available at:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/289105/River\\_Trent\\_Catchment\\_Management\\_Plan.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289105/River_Trent_Catchment_Management_Plan.pdf)

<sup>5</sup> URS (2012) Surface Water Management Plan (SWMP). Available at:  
<https://www.leicester.gov.uk/media/178251/swmp-main-report.pdf>



## 2. Lead Local Flood Authority Responsibilities

### 2.1 Introduction

The preparation of a PFRA is just one of several responsibilities of LLFAs under the 2009 legislation. This section provides a brief overview of other responsibilities LCC are obliged to fulfil under their role as a LLFA. Figure 2-1 presents the defined roles of the LLFA in accordance with the Local Flood Risk Management Strategy (LFRMS).

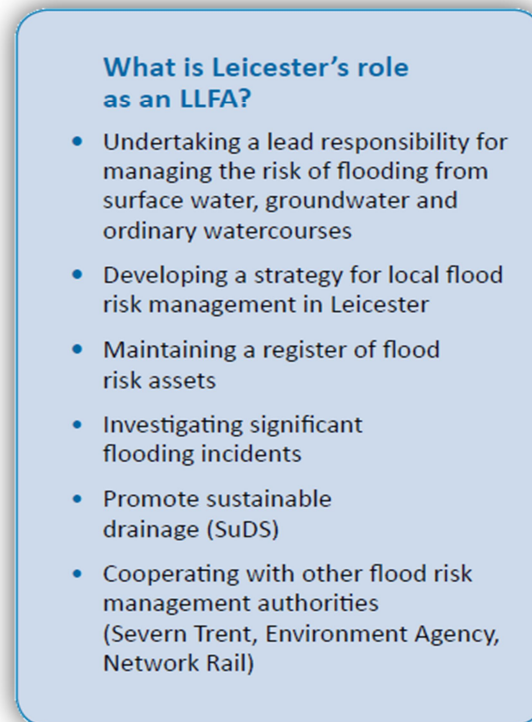


Figure 2-1: Leicester's roles as defined in their LFRMS.

### 2.2 Leadership and Partnership

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

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

### 2.3 Existing Flood Risk Collaboration

LCC actively participates in an existing collaborative flood risk partnership in the region. Under the Local Resilience Forum (LRF), a Flood Risk Management Board with representatives from LCC, Leicestershire County Council, Rutland County Council and other key stakeholders such as the Environment Agency, meet quarterly to review and coordinate LLFA actions and cross-boundary issues.

There are also plans to develop a Planning Group to feed into the LRF. In the meantime, a representative from the LCC Housing Planning and Infrastructure Group sits on the Flood Risk Management Board.

Collaboration between LCC, the County and Districts also occurs through the Leicester & Leicestershire Local Economic Partnership. A working group on policies affecting the Principal Urban Area (PUA) is co-ordinated by the Housing Planning and Infrastructure Group which can be developed to enable cross-boundary working on flood risk and planning.

LCC also has an existing internal, inter-service flood risk collaboration. The City Highways, Emergency Management, Planning, including Design and Conservation and Information Services teams currently work together on flood risk issues. This is overseen by the Director of Corporate Governance within the City Council.

## 2.4 Managing and Maintaining Flood Risk Partnerships

LCC as the Lead Local Flood Authority (LLFA) have established a 'LLFA Board' and have identified six main functions that the board will fulfil. Following the function theme, LCC have identified internal members for the board and have also specified working groups. The LLFA board work with and complement the existing Flood Risk Management Board at the LRF level so that LCC continue to work closely with neighbouring LLFAs and key stakeholders. LCC have also formalised the way that council services work together around these functions and have identified a working and reporting structure that form the corporate governance of the Lead Local Flood Authority Board.

Contributing departments will all report through the Chair of the LLFA Board (the Chair of which has already been identified as the Director of Planning, Development and Transportation) to the Reducing Carbon Footprint Priority Board, which in turn reports to the City Mayor and Cabinet. The Overview and Scrutiny Management Board will scrutinise operations of the LLFA Board in addition to reviewing and scrutinising reports, strategies, proposed options and other outputs.

The LLFA Board maintains close links and communications with the external partners and key stakeholders, who will also be invited to comment on and contribute to the operations of the Board.

The internal membership structure of the LLFA Board is presented in Figure 2-2. The reporting and governance structure of the LLFA Board is presented in Figure 2-3.

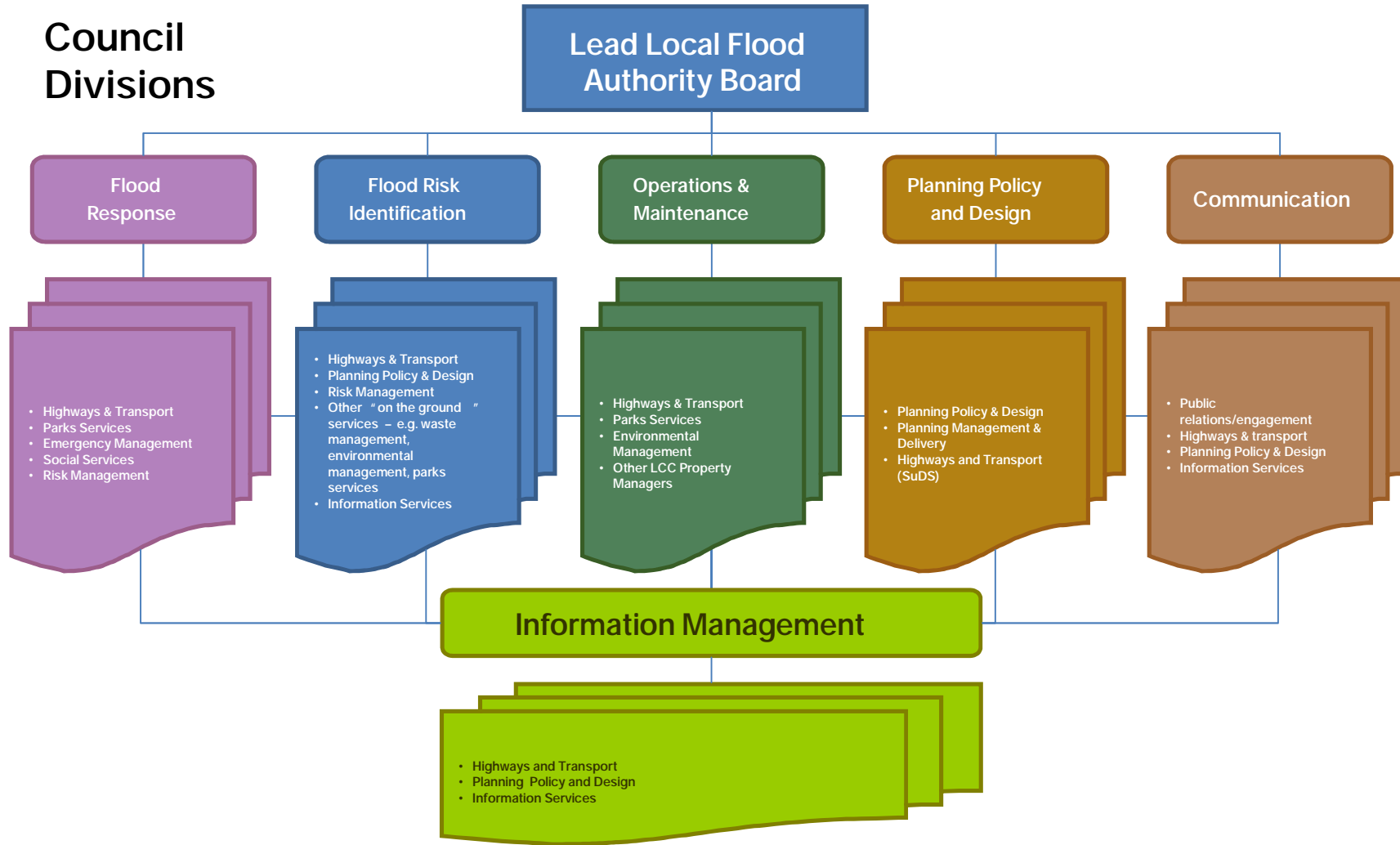
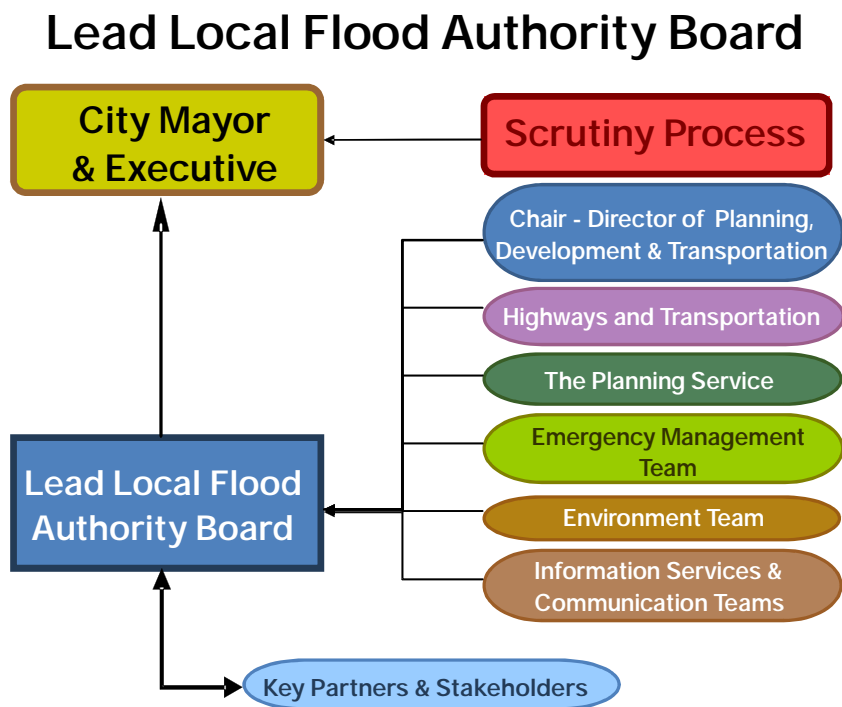


Figure 2-2: Internal Membership Structure of the Leicester City Council Lead Local Flood Authority



**Figure 2-3: Reporting and Governance Structure for the Leicester City Council Lead Local Flood Authority Board**

Key to the success of any flood risk partnership is the sharing and management of knowledge and LCC recognise this as underpinning successful flood risk management across the City. Another key component is communication at different levels from Council members to the general public.

LCC are committed to working collaboratively and in partnership with key stakeholders, neighbouring authorities and across departments to ensure that flood risk management in the area is properly coordinated and is carried out in a sustainable and efficient manner. To ensure that this is recognised within the LLFA Board, LCC have identified external partners under the same functions as the internal structure to allow for a consistent approach to flood risk management (Figure 2-2).

## 2.5 Stakeholder Engagement

As part of the preparation of the 2011 PFRA and SWMP for Leicester (2012), stakeholders have been and will continue to be engaged representing the following organisations and authorities:

- Environment Agency
- Severn Trent Water
- Neighbouring Authorities and LLFAs
- Canal and Rivers Trust
- Network Rail
- Trent Rivers Trust
- Leicestershire Fire and Rescue Services
- Highways Agency
- Natural England
- Critical Service – NHS/Utilities

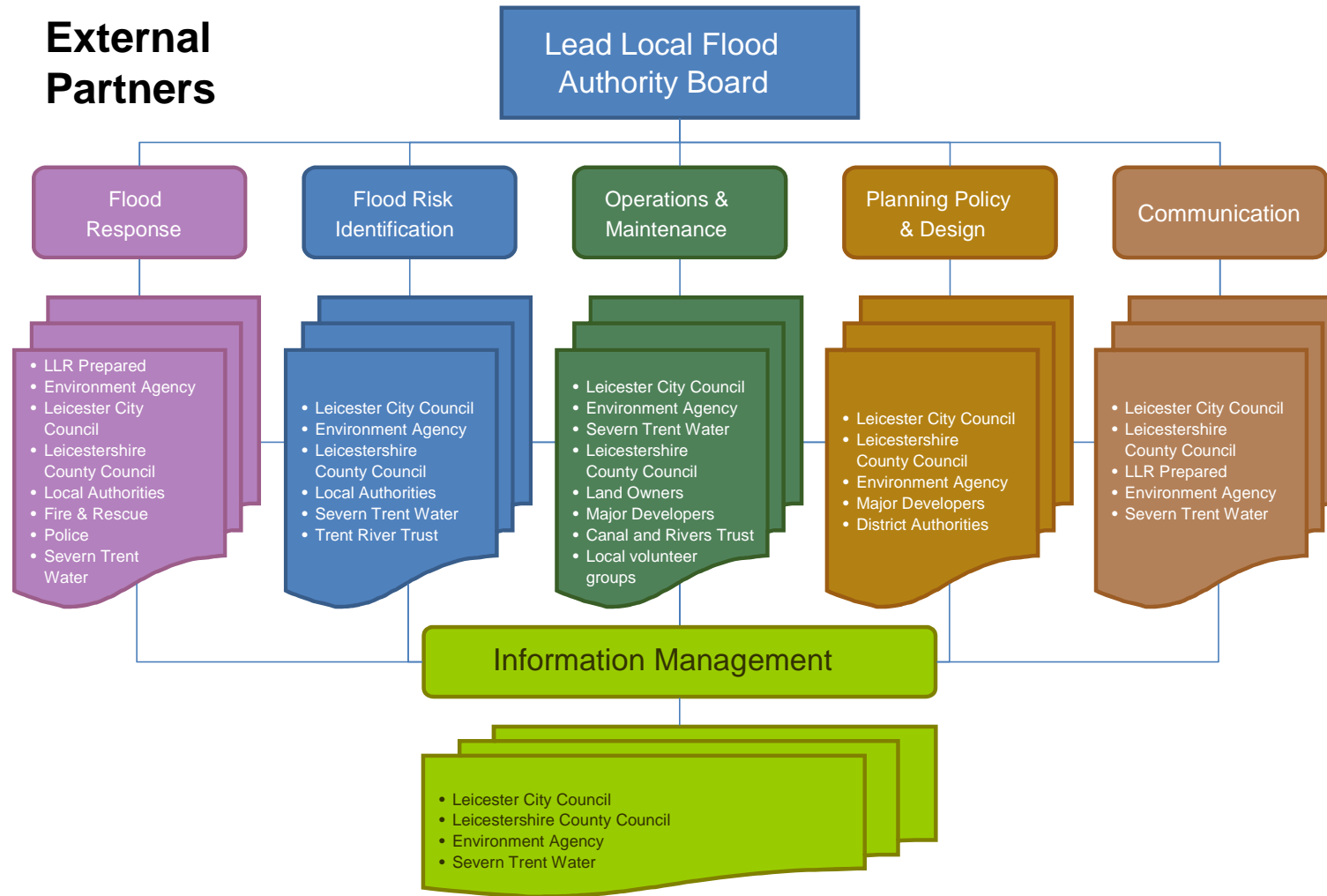


Figure 2-4: External Partners of the Leicester City Council Lead Local Flood Authority

## 2.6 Public Engagement

It is recognised that members of the public may also have valuable information to contribute to the PFRA and to local flood risk management more generally across Leicester. Stakeholder engagement can provide significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

However it is also recognised that it is crucial to plan the level and timing of engagement with communities predicted to be at risk of flooding from surface water, groundwater and ordinary watercourses. This is to ensure that the potential for future management options and actions is adequately understood and costed without raising expectations before solutions can reasonably be implemented.

It is important to undertake some public engagement when formulating local flood risk management plans (for the Flood Risk Area covering Leicester) as this will help to inform future levels of public engagement.

LCC have held a number of public engagement events targeted at certain areas of the City to highlight levels of risk and to communicate and gather public opinion on studies or proposed flood risk management activities.

## 2.7 Further Responsibilities

Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for Lead Local Flood Authorities from the Flood & Water Management Act and the Flood Risk Regulations. These responsibilities include:

- Investigating flood incidents – LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.
- Asset Register – LLFAs also have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
- Lead Local Flood Authority SuDS – LLFAs are delegated approval body for reviewing and advising on SuDS design during the planning phase. However, they are not obliged to adopt any SuDS features.
- Local Strategy for Flood Risk Management – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.
- Works Powers – LLFAs have powers to undertake works to manage flood risk from surface water runoff and groundwater, consistent with the local flood risk management strategy for the area.
- Designation powers – LLFAs, as well as district councils and the Environment Agency (EA) have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.

## 3. Methodology and Data Review

### 3.1 Data Sources and Availability

The approach for producing this PFRA was based upon the Environment Agency's Review of preliminary flood risk assessments guidance, which was released in January 2017, available to all LLFAs. The PFRA is based on readily available or derivable data and with this in mind; the following methodology has been used to undertake the PFRA.

### 3.2 Methodology

#### 3.2.1 Data Collection from Partner Organisations

The following authorities and organisations were identified and contacted to share data for the preparation of the PFRA; LCC, Severn Trent Water, Canal and Rivers Trust and the Environment Agency.

#### 3.2.2 Assessing Historic Flood Risk

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

Historical flood risk has been examined in the Leicester City Council boundary from geo-referenced data provided by the City Council. This geo-referenced data was subsequently mapped and can be found within Appendix A Figure A1 of this PFRA Update. The displayed data is mapped for the years 2015 to 2017. This visual representation of historical flood risk allows the data to be viewed in a spatial context.

#### 3.2.3 Assessing Future Flood Risk

The identification of Flood Risk Areas through the PFRA should also take into account future floods. The assessment of future flood risk will primarily rely on a combination of a technical review of the Environment Agency's updated Flood Map for Surface Water (see Appendix A, Figure A2), of the Leicester SWMP pluvial hydraulic modelling outputs (see Appendix A, Figure A3) and of the Environment Agency's Areas Susceptible to Groundwater Flooding map (see Appendix A, Figure A4) to further inform future flood risk at national and local level.

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

The National Planning Policy Framework (NPPF)<sup>6</sup> sets out a vision for the planning system to help minimise vulnerability and provide resilience to the impact of climate change. The NPPF Planning Practice Guidance (PPG): Flood Risk and Coastal Change<sup>7</sup> explains how flood risk should be managed now and in the future, with consideration to climate change allowances as published by the Environment Agency in February 2016<sup>8</sup>.

<sup>6</sup> Department for Communities and Local Government (March 2012) National Planning Policy Framework. Available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/6077/2116950.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf).

<sup>7</sup> Department for Communities and Local Government (2014) *Planning Practice Guidance: Flood Risk and Coastal Change*. Available at: <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/> [Accessed: 21/04/2016]

<sup>8</sup> Environment Agency/Defra (2016) Flood Risk Assessments: climate change allowances. Available at <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Table 3-1 displays the predicted Humber River Basin peak river flow climate change allowances and Table 3-2 displays the predicted extreme rainfall intensity climate change allowances based on climate change projections and different scenarios of carbon dioxide (CO<sub>2</sub>) emissions to the atmosphere. There are different allowances for different epochs or periods of time over the next century. More information can be found in Section 5.4.1.

**Table 3-1: Humber River Basin Peak River Flow Climate Change Allowances**

River Basin District	Allowance category	Total Potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Humber	Upper End	20%	30%	50%
	Higher Central	15%	20%	30%
	Central	10%	15%	20%

**Table 3-2: Peak Rainfall Intensity Allowances in Small and Urban Catchments (1961-1990 baseline)**

Applies across all of England	Total potential change anticipated for the 2020s	Total potential change anticipated for the 2050s	Total potential change anticipated for the 2080s
Upper End Estimate	10%	20%	40%
Central	5%	10%	20%

### 3.2.4 Identifying Flood Risk Areas

Information regarding historic and future flood risk will be used to formally identify Flood Risk Areas. To achieve this, flood risk indicators will be used to determine the impacts of flooding on human health, economic activity, cultural heritage and the environment. The use of flood risk indicators helps to develop understanding of the impacts and consequences of flooding. Key flood risk indicators are summarised in Table 3-3.

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

Impacts of flooding on:	Flood Risk Indicators
Human Health	Number of residential properties. Critical Services (hospitals, police/fire/ambulance stations, schools, nursing homes etc).
Economic Activity	Number of non-residential properties. Length of road or rail. Area of agricultural land.
Cultural Heritage	Cultural heritage sites (world heritage sites).
Environment	Designated sites (SSSIs, SACs, SPAs, etc) and BAP habitat.

The above indicators have been selected and analysed by Defra and the Environment Agency in order to identify areas where flood risk and potential consequences exceed a pre-determined threshold. The areas have been identified using a combination of two methodologies. Firstly, a cluster analysis whereby, the "blue squares" were identified wherever at least 200 people or 20 non-residential properties or more than one key service might be flooded. Secondly and finally, the Office for National Statistics, built-up areas (BUAs) have been used to analyse surface water risk. BUAs include areas of built-up land with a minimum of 20 hectares (200,000m<sup>2</sup>). Any areas with less than 200 metres between them are linked to become a single BUA, with built-up area sub-divisions (BUASDs). Where available, the Environment Agency have used BUASDs to provide greater granularity of communities in large urban areas. Where this approach identifies 3000 or more reportable properties at risk of surface water flooding, the BUA/BUASD forms an indicative Flood Risk Area.



From the Environment Agency guidance<sup>9</sup>, in some locations, clusters of blue squares from method 1 and BUA/BUASDs from method 2 overlap. Where this occurs, the indicative Flood Risk Area is the total extent of the two areas combined.

### 3.3 Data Sources and Availability

Table 3-4 catalogues the relevant information and datasets held by partner organisations and provides a description of each of the datasets. Much of this data was collected as part of the ongoing LCC SWMP (see Appendix B of the SWMP for a register of data collected).

**Table 3-4: Relevant Information and Datasets**

	Dataset	Description
Environment Agency Data	updated Flood Map for Surface Water	The updated (third generation) national surface water flood mapping which was released in 2013. This dataset includes three flooding return periods 1 in 30, 1 in 100 and 1 in 1000. Additionally, depth/hazards layers were created by the Environment Agency to further inform surface water risk.
	Flood Map (Rivers and the Sea)	Shows the extent of flooding from rivers with a catchment of more than 3km <sup>2</sup> and flooding from the sea.
	Areas Susceptible to Groundwater Flooding	Coarse scale national mapping showing areas which are susceptible to groundwater flooding.
	Indicative Flood Risk Areas	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
	Historic Flood Map	Attributed spatial flood extent data for flooding from all sources.
	River Trent (CFMP)	CFMPs consider all types of inland flooding from rivers, groundwater, surface water and tidal flooding and are used to plan and agree the most effective way to manage flood risk in the future.
	Strategic Flood Risk Mapping reports, models and outputs	Under the Environment Agency's Strategic Flood Risk Mapping programme, detailed river models and flood risk maps have been produced for the main rivers in Leicester.
Leicester City Council	Strategic Flood Risk Assessments (SFRA)	SFRAs contain useful information on historic flooding, including local sources of flooding from surface water, groundwater, ordinary watercourses and canals.
	Historical flooding records	Historical records of flooding from surface water, groundwater and ordinary watercourses including reports from 1993, 1998, 1992. Location of Flood Retention Basins. LCC also contain an internal database of records from 2011-2017.
Severn Trent Water	DG5 Register for Severn Trent areas	DG5 Register logs and records of sewer flooding incidents in each area.
Canal and Rivers Trust	Canal and Rivers Trust network	Detailed GIS information on the Canal and Rivers Trust network, including the location of canal centrelines, sluices, locks, culverts, etc.
	Records of canal breaches and overtopping events	Records of historical canal breaches and canal overtopping events across Leicester.

<sup>9</sup> Environment Agency (January 2017) Review of preliminary flood risk assessments (Flood Risk Regulations 2009): guidance for lead local flood authorities in England.

## 3.4 Data Limitations

A brief assessment of the data collection and review process is included in this section to provide transparency with respect to the methodology. LCC and their key stakeholders are aware of many of the limitations that existing datasets present. As part of their duties under the Flood and Water management Act, LCC are formally recording flood incidents and maintaining an asset register that will improve the quantity, quality and consistency of future flood risk datasets. A number of issues arose during the data collection process, as described below:

### 3.4.1 Inconsistent Recording Systems

Flood events are currently recorded by the City Highways Team. However, incidents are also recorded by other departments within the council such as the Emergency Management Team or the Environment Team.

Since the production of the previous PFRA in 2011<sup>10</sup>, Leicester City Council now have much more consistent flood recording process. An established database has now been produced and is updated in two methods. Firstly, when a member of the public either phones or emails either Highways or Flooding – this information will be recorded appropriately. Secondly, the City Council now have a 'Report A Flood' section on their website which can be found directly here: <http://www.leicester.gov.uk/transport-and-streets/roads-and-pavements/>.

Overall, the City Council now have a much more consistent recording system and have established a mature database to demonstrate in depth flooding history.

### 3.4.2 Incomplete Data Sets

The Highways team holds digital records (excel and also in GIS) of locations affected by flooding from 1983 to present day. They also hold some paper records of other historical flood events together with locations known to regularly flood during heavy rainfall. However, as highlighted above, some of the datasets collated are not exhaustive and may not accurately represent the complete flood risk issues in a particular area. This is to be expected with historical datasets but nonetheless could impact on the identification of flood risk areas.

### 3.4.3 Records of Consequences of Flooding

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

## 3.5 Quality Assurance

The datasets used to inform this PFRA were collected for the LCC SWMP and Level 2 SFRA. All data received has been subject to quality assurance measures to monitor and record the quality and relevance of the data and information. A data quality score was given, which is a qualitative assessment based on the Data Quality System provided in the SWMP Technical Guidance document (March 2010). This system is explained in Table 3-5.

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<sup>10</sup> Leicester City Council (2011) Preliminary Leicester Flood Risk Assessment. Available at: <https://www.leicester.gov.uk/media/178227/leicester-city-pfra-september-2011.pdf>

**Table 3-5: Data Quality System for SWMP Technical Guidance<sup>11</sup> (March 2010)**

Data Quality Score	Description	Explanations	Example
1	Best available	No better available; not possible to improve in the near future	High resolution LiDAR, river flow data, rain-gauge data
2	Data with known deficiencies	Best replaced as soon as new data is 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 surface water flooding
4	Heroic assumptions	An educated guess	Ground roughness for 2d models

### 3.6 Security, Licensing and Use Restrictions

A number of datasets used in the preparation of this PFRA are subject to licensing agreements and use restrictions. The following national datasets provided by the Environment Agency are available to local authorities and their consultants for emergency planning and strategic planning purposes:

- Flood Map for Planning (Rivers and Sea),
- updated Flood Map for Surface Water,
- Areas Susceptible to Groundwater Flooding (ASStGWF), and
- National Receptor Database

A number of the data sources used pertaining to Leicester are publicly available documents, such as:

- Leicester Strategic Flood Risk Assessment<sup>12</sup>,
- Humber River Basin District River Basin Management Plan<sup>13</sup>
- River Trent Catchment Flood Management Plan<sup>14</sup>, and
- Leicester Surface Water Management Plan<sup>15</sup>

The use of some of the datasets made available for this PFRA has been restricted. These include records of properties flooding held by the Council and Severn Trent Water Ltd. Necessary precautions must be taken to ensure that all information given to third parties is treated as confidential and is in accordance with data and licensing agreements. The information must not be used for anything other than the purpose stated in the agreement. No information may be copied, reproduced or reduced to writing, other than what is necessary for the purpose stated in the agreement.

Some datasets may only be licensed for use by the Council for a limited period of time and this should be taken into account when updates or revisions are made to the PFRA or subsequent studies. The security of data is also a key consideration when it comes to collecting, collating and storing sensitive data. All data collected is stored on local servers which are password protected. Leicester City Council must adhere to these data security measures to ensure that sensitive data is held in a secure manner.

<sup>11</sup> Defra (June 2011) Surface Water Management Plan Technical Guidance. Available at: <https://www.gov.uk/government/publications/surface-water-management-plan-technical-guidance>

<sup>12</sup> LCC are currently reviewing their Strategic Flood Risk Assessments

<sup>13</sup> Defra/Environment Agency (February 2016) Part 1: Humber river basin district River basin management plan. Available at: <https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan>

<sup>14</sup> Environment Agency (December 2009) River Trent Catchment Flood Management Plan. Available at: <https://www.gov.uk/government/publications/river-trent-catchment-flood-management-plan>

<sup>15</sup> URS (2012) Leicester Surface Water Management Plan. Available at: <https://www.leicester.gov.uk/your-environment/flooding-and-severe-weather/flood-risk-studies/>

## 4. Past Flood Risk

### 4.1 Overview of Historic Flooding in Leicester

Flood records across Leicester were collected from the data sources discussed in Table 3-3. Records of over 3202 historical flood events and flooding hotspots were collected across LCC's administrative area. Where the grid references of these incidents were recorded, they have been mapped in Appendix A, Figure A1.

From the previous PFRA, Leicester City Council have records of flooding date back to the early 1980's. However, contained in this PFRA update, more recent records of flooding have been graphed in Figure 4-1 from 2011 until early 2017. This update should be read in conjunction with the previous PFRA produced in 2011 for a greater understanding of historical flood risk. It has been noted that due to the significant increase in recorded flooding incidents that the LCC website for 'reporting floods' has been successful in gaining a more detailed record of incidents.

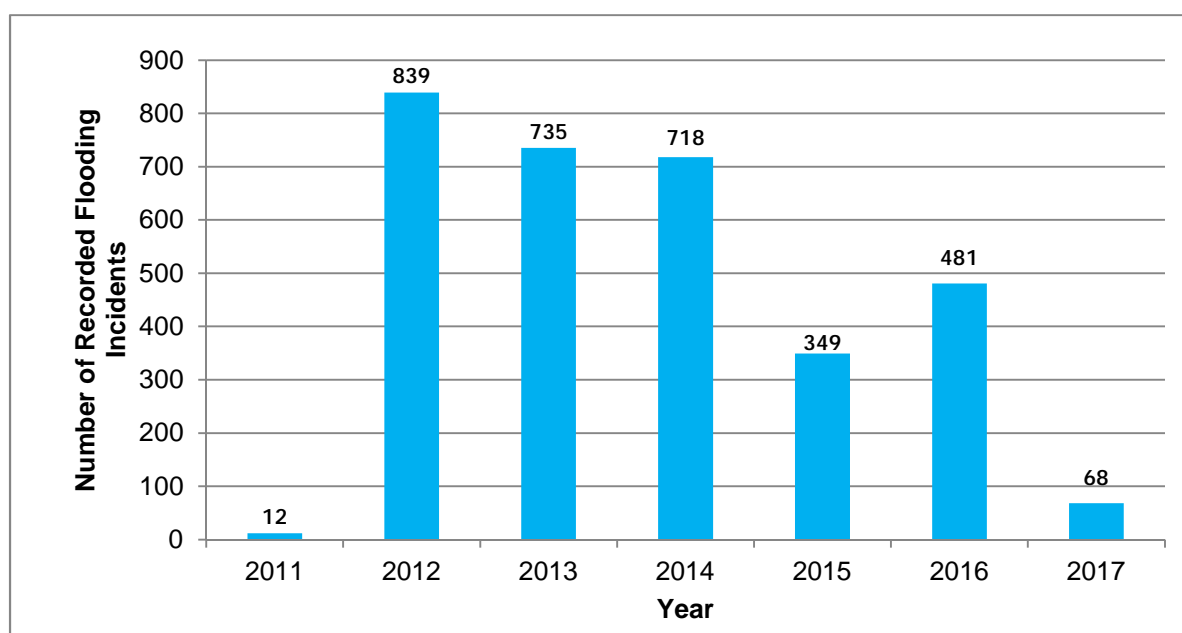


Figure 4-1: Total Number of Recorded Historical Flooding Incidents in Leicester (per year 2011-2017)

These flood events came from a range of flood sources including blocked drains and gullies, sewers, ordinary watercourses and surface water flooding. In some cases the source of flooding was unknown or not recorded.

Table 4-1 provides a summary of the consequences of the recorded floods where the information was available. Where this information was not readily available, this has not been accounted for.

Table 4-1: Summary of Recorded Flooding Issues

Flood Year	Source of Flooding	Consequences of Flooding
2011	Pluvial and blocked gullies	Carriageway flooding and garden flooding
2012	Pluvial, fluvial, groundwater, blocked gullies and sewerage issues	Carriageway flooding, garden flooding and flooded pavements
2013	Pluvial, fluvial, blocked gullies and sewerage issues	Flooded basements, carriageway flooding, garage flooding, car park flooding and flooded pavements
2014	Blocked gullies, pluvial and sewerage issues	Carriageway flooding, pavement flooding, car park flooding and cellar flooding
2015	Blocked gullies and pluvial flooding	Carriageway flooding and garden flooding
2016	Blocked gullies	Carriageway flooding, pavement flooding and garden flooding
2017	Blocked gullies	Carriageway flooding

A summary of information specific to each source of flooding considered as part of the PFRA is included below. However, a similar table appears in the previous 2011 PFRA that should also be viewed for a holistic summary of historical flooding.

## 4.2 Surface Water Flooding

Surface water flooding occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground. Pluvial/surface water flooding has historically and continues to be a significant problem in Leicester. The flashy nature and short duration of such events has made them difficult to predict and protect against. Numerous events have been recorded in the past and are included on Figure 4-1.

## 4.3 Flooding from Ordinary Watercourses

Flooding from ordinary watercourses can occur as a result of the channel capacity being exceeded, a blockage occurring, or as a result of small culverted sections surcharging.

Several ordinary watercourses have caused flooding in the past and some records exist for these incidents. The main consequence appears to be flooding to roads and gardens, but properties have also been affected. Ordinary watercourses that are known to have flooded include Portwey Brook, Ethel Brook, Gilroes Brook, Hol Brook and Wash Brook.

## 4.4 Flooding from Canals

Information was obtained from the Canal and Rivers Trust which details the canal network throughout Leicester, including the location of canals, weirs, sluices and locks.

## 4.5 Groundwater Flooding

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

Groundwater flooding incidents are thought to have occurred in Leicester in the past and have affected basements, cellars and other underground facilities. However, according to Council officers, it is often unclear as to whether the flooding is caused as a result of high groundwater levels or as a result of nearby drainage and distribution networks (burst water pipes, broken sewers etc) or other local factors.

## 4.6 Sewer Flooding

In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water known as 'combined sewers'. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity. Due to the potential for sewer flooding in urbanised areas, the data that utility companies hold on the public sewer network can be of high importance in identifying possible flood sources for an area.

Much of the sewer network in Leicester could date back to Victorian times and sections of the network are of unknown capacity and condition. More recent sewers are likely to have been designed to the guidelines in "Sewers for Adoption" (WRC, 2013)<sup>16</sup>. These sewers tend to have a design standard of up to the 1 in 30 year storm event (equating to approximately a 1 in 5 year flood flow), although in many cases, it is thought that this design standard is not achieved, especially in privately owned systems.

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<sup>16</sup> Sewers for Adoption, accessed on 21/04/2017 at:  
[http://sfa.wrcplc.co.uk/Data/Sites/4/Gallery/Images/WebImages/pdfs/SFA7smalldev\\_sep2013.pdf](http://sfa.wrcplc.co.uk/Data/Sites/4/Gallery/Images/WebImages/pdfs/SFA7smalldev_sep2013.pdf)

Severn Trent Water (STW) are keen to participate in flood risk management in Leicester and have agreed to share with LCC certain datasets that can assist in identifying flood sources in the city, one of which was the DG5<sup>17</sup> register of sewer flooding (terms and conditions apply due to the potentially sensitive information contained in the datasets which may mean that some data cannot be shared publicly).

In order to fulfil statutory commitments set by OFWAT, water companies must maintain verifiable records of sewer flooding, which is achieved through their DG5 registers. Water companies are required to record flooding arising from public foul, combined or surface water sewers and identify where properties have suffered internal or external flooding. The DG5 register does not however indicate areas or properties at risk of future flooding. The register is used primarily to identify incidents of recorded flooding only.

DG5 registers from Severn Trent Water were analysed to investigate the occurrence of sewer flooding incidents across Leicester. Sewer flooding has been recorded at numerous locations in the study area. This includes both surface water (643 events) and foul water (636 events) and both internal (66 events) and external flooding (100).

It is important to note that the DG5 register indicates areas reported to STW that have experienced flooding in the past (typically the last 10 years) as a result of insufficient hydraulic capacity in the sewer network. The flood records provided could be misleading as they may not be a complete and accurate record of flood events in the study area as some minor flooding incidents may go unreported, particularly if no property is affected by internal flooding.

Furthermore, maintenance work may have been undertaken by STW since the flooding incident(s) occurred. Sewer flooding models provide a much more detailed and useful appreciation of the risk posed. However much of this work is not yet publicly available due to commercially sensitive issues or the Data Protection Act (1998)<sup>18</sup>.

Until more detailed and suitable data becomes available, LCC, the EA and STW have agreed to continue to liaise to determine how sewer flooding data can best be used to inform flood risk management in Leicester.

## 4.7 Consequences of Historic Flooding

The Regulations require LLFAs to assess historical flood events that have had significant or harmful consequences. A significant or harmful flood event is one that can be viewed as serious enough to be reported to Europe and must therefore be assessed as part of the PFRA and included in Annex 1 of the Preliminary Assessment Spreadsheet (see Appendix C).

However, this does not prevent LLFAs from including details of less severe historical flood events within the PFRA if they are considered relevant and useful to demonstrate flood risk issues. The Environment Agency indicate<sup>1</sup> that the following factors may be taken into account by LLFAs when assessing whether a historic flood event had significant harmful consequences:

- Flooding was registered on a national scale, even if only occurring over a relatively small period,
- The flood event was memorable or notable,
- Flooding is considered by a LLFA to be significant (based on local knowledge) when taking into account the scale, harmful consequences (for human health, economic activity and the environment) and the level of response (for example, did it result in the formation of a strategic flood risk management group),
- The scale of the flood impacts and also their severity. For instance, internal flooding of a large number of properties is likely to be considered significant, but flooding to a large number of gardens is not, and

<sup>17</sup> Leicester City Council are aware that Severn Trent are producing a new DG6 register, therefore have stopped issuing the old DG5 register.

<sup>18</sup> Data Protection Act 1998, available at: <http://www.legislation.gov.uk/ukpga/1998/29/contents>

- The quality of recorded information is sufficient to determine if there were 'significant harmful consequences'.

As a result of the issues discussed in Section 3.4, insufficient data is available to draw definitive conclusions on the significance and consequences on people, the economy and the environment, of most of the recorded historic flood events. Only two of the incidents – July 1968 and June 1993 – have any information on the numbers and types of properties affected. Records suggest that flooding for both events occurred through a combination of surface water, sewer flooding, and ordinary watercourses overtopping.

The July 1968 flood event reportedly affected 1800 homes and 28 factories and so clearly had consequences on people and the economy (the worst recorded flood event in Leicester). Using a figure of 2.34 people per household, (based on the Office of National Statistics guidance), 4,212 people may have been affected by the July 1968 flood event. Similarly, the June 1993 event affected approximately 71 homes, which may have affected 166 people. As a result these two historic flood events have been considered to have had 'significant harmful consequences' and therefore have been recorded in Annex 1 of the Preliminary Assessment Spreadsheet (see Appendix C).

It should also be noted that following the 1968 flood event, a significant programme of flood risk management measures was implemented in Leicester, including flood storage basins, watercourse channels works and constructions of walls and embankments.

Flood records do exist for Leicester before 1968, however the quality and accuracy of these records is uncertain. In addition, land use, watercourse routes, drainage and flood risk infrastructure have changed significantly therefore the relevance of these events are thought to be less significant to current and future flood risk management in Leicester.

A complete record of locations where flooding has occurred will be kept by LCC as a future evidence base. This database will be built up in the future through ensuring full details of flood events are recorded; this will then be used to support and inform future PFRA cycles as well as other flood risk management projects the city council complete in due course.

## 5. Future Flood Risk

### 5.1 Overview of Future Flood Risk

#### 5.1.1 Surface Water Flooding

The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three magnitude rainfall events:

1. High Probability - 3.3% AEP (1 in 30 chance of flooding in any one year),
2. Medium Probability - 1% AEP (1 in 100 chance of flooding in any one year) and
3. Low Probability - 0.1% AEP (1 in 1,000 chance of flooding in any one year).

The latest version of the mapping, published in 2013, is referred to as the 'updated Flood Map for Surface Water' (uFMfSW) and the extents have been made available to planning authorities as GIS layers (see Appendix A, Figure A2). This dataset is also available on the Environment Agency website, and is referred to as 'Risk of Flooding from Surface Water'.

The uFMfSW provides all relevant stakeholders, such as the Environment Agency, LCC, STW and the public access to information on surface water flood risk which is consistent across England and Wales<sup>19</sup>. The modelling helps the Environment Agency take a strategic overview of flooding, and assists LCC (as the LLFA) in their duties relating to management of surface water flood risk.

The Surface Water Management Plan (SWMP) for Leicester City Council has already been produced and published on the council website. Results from the pluvial hydraulic modelling have been used to produce a pluvial flood risk map which is included in Appendix A, Figure A3.

For the purposes of this PFRA, the mapping allows an improved understanding of areas within the City which may have a surface water flood risk.

#### 5.1.2 Flooding from Ordinary Watercourses

The fluvial flood map has been used to assess the risk of flooding from ordinary watercourses. The Detailed River Network was used to identify ordinary watercourses and this was cross referenced with the Flood Map for Rivers and the Sea to assess future flood risk from this source.

However, as the methodology applied to generate the Flood Map prioritises Main Rivers, and only includes catchments with an area >3 km<sup>2</sup>, there is insufficient data in the Flood Map regarding ordinary watercourses within the study area to make an accurate assessment of the future flood risk associated with them. As part of the LCC SWMP, 8 ordinary watercourses were therefore modelled in greater detail to assess what the future flood risks may be.

Outputs from this modelling, including flood extents, depths, velocities and hazard classifications were reviewed as part of the SWMP by the Lead Local Flood Board and key stakeholders (including the Environment Agency). These have since been used by LCC to identify flood risk areas in Leicester as part of this PFRA Update.

#### 5.1.3 Flooding from Canals

The navigable reach of the Grand Union Canal River Soar that interlinks with the River Soar through the centre of Leicester has been modelled in detail by the Environment Agency. The predicted future risk of flooding from this source is illustrated in the Flood Map for Planning<sup>20</sup> produced by the Environment Agency. However, the Canal and Rivers Trust are currently working on a study to better understand the future flood risk from canals, which will be available to inform the third cycle of the PFRA process.

<sup>19</sup> Environment Agency (2013) 'What is the updated Flood Map for Surface Water?'

<sup>20</sup> Environment Agency (2017) Flood Map for Planning (River and Sea). Available at: <https://flood-map-for-planning.service.gov.uk/>. Accessed on 5<sup>th</sup> May 2017.



### 5.1.4 Groundwater Flooding

Groundwater flooding usually occurs in areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground. Where emergence of groundwater occurs these areas would be at greatest risk and the impact of any such occurrence would potentially be exacerbated by the influence of climate change.

The Environment Agency released a dataset entitled Areas Susceptible to Groundwater Flooding (AStGWF) in March 2011 (see Appendix A, Figure A4). This data has used the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flooding Susceptibility Map and thus covers consolidated aquifers (sandstone etc., termed 'clearwater' in the data attributes) and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It shows the proportion of each 1 km grid square where geological and hydrogeological conditions show that groundwater might emerge.

The susceptible areas are represented by one of four area categories (listed below) showing the percentage of each 1 km<sup>2</sup> grid that is susceptible to groundwater emergence.

- < 25%,
- >= 25% <50%,
- >= 50% <75%, and
- >= 75%.

It does not show the likelihood of groundwater flooding occurring. Absence of values for any grid square means that no part of that square is identified as being susceptible to groundwater emergence. For the purposes of this PFRA, the mapping allows an improved understanding of areas within the City which may have a susceptibility to groundwater flood risk.

## 5.2 Locally Agreed Surface Water Information

A definition of 'locally agreed surface water information' has been considered in conjunction with the Environment Agency and Severn Trent Water in order to agree what surface water information best represents local conditions across Leicester. Currently the uFMfSW, which gives an overview of the future flood risk from surface water across Leicester, forms the agreed available surface water flooding information in Leicester.

The SWMP for Leicester included city-wide pluvial modelling however, the Environment Agency also provided the uFMfSW dataset which also includes Leicester City Council. The City Council use both data sets but primarily focus on the uFMfSW as this is most up-to-date.

## 5.3 Potential Consequences of Future Flooding

The Environment Agency has used the uFMfSW mapping and the NRD to identify a number of areas across the country which exceed a given threshold, described in Table 5-1 below.

**Table 5-1: Flood Risk Threshold Used to Identify Future Consequences of Flooding**

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

The potential consequences on key flood risk indicators (as discussed in Table 3-3) have been assessed by the Environment Agency; this information has been included in Annex 2 of the Preliminary Assessment Spreadsheet (see Appendix C).

## 5.4 Climate Change and Long Term Developments

### 5.4.1 The Impacts of Climate Change

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

There was consensus amongst climate model projections presented in the IPCC Sixth Assessment Report for northern Europe suggesting that in winter high extremes of precipitation are very likely to increase in magnitude and frequency. These models project drier summers with increased chance of intense precipitation — intense heavy downpours interspersed with longer, relatively dry periods (Solomon et al., 2007).

The pluvial and ordinary watercourse modelling undertaken as part of the LCC SWMP simulated the potential effects of climate change on flood risk in Leicester during the 1 in 100 year (1% Annual Exceedance Probability (AEP)) event.

#### UKCP09

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

- By the 2080s, under Medium emissions, over most of lowland UK central estimates are for heavy rain days (rainfall greater than 25 mm) to increase by a factor of between 2 and 3.5 in winter, and 1 to 2 in summer.
- By the 2080s, under Medium emissions, across regions in England & Wales the central estimate (50% probability) for winter mean precipitation % change ranges from +14 to +23. Central estimate for summer mean precipitation % change ranges from -18 to -24.

Certain key processes such as localised convective rainfall are not represented within this modelling so there is still considerable uncertainty about rarer extreme rainfall events for the UK. It can be more certain that heavy rainfall will intensify in winter compared to summer. The proportion of summertime rainfall falling as heavy downpours may increase. The impact of these changes on local flood risk is not yet known.

The UKCP09 climate change projections are currently being revised under UKCP18 as announced by the Department of Environment, Food and Rural Affairs (DEFRA) on 15<sup>th</sup> January 2016. However, currently DEFRA are adhering to the UKCP09 projection guidance. The Met Office have made available through UK Climate Projections a supplementary question and answer section of their website regarding the UKCP09 projections. This can be accessed directly here: <http://ukclimateprojections.metoffice.gov.uk/24126>.

#### Planning Practice Guidance: Flood Risk and Coastal Change

The PPG Flood Risk and Coastal Change<sup>7</sup> refers to the new climate change allowances published by the Environment Agency in February 2016, which have adopted a regionalised approach whereby climate change allowances (% increases in flows) are provided for each river basin district over three different timeframes (epochs) and for three different emissions scenarios. Local planning authorities refer to this when preparing local plans and considering planning applications.

As stated in Section 3.2.3, Table 3-1 displays the predicted Humber River Basin peak river flow climate change allowances and and Table 3-2 displays the predicted extreme rainfall intensity

climate change allowances based on climate change projections and different scenarios of carbon dioxide (CO<sub>2</sub>) emissions to the atmosphere. The latest guidance also provides climate change allowances for sea level rise and offshore wind speed and extreme wave height.

#### 5.4.2 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, NPPF PPG 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."

The Leicester City Council, Strategic Flood Risk Assessment (FRA) (2012) and the Leicester City Council Local Flood Risk Management Strategy (LFMRS) (2015) both aim to reduce through the use of policy, flood risk from new development in Leicester City Council.

The Leicester Strategic Flood Risk Assessment (2012) can be accessed directly from: <https://www.leicester.gov.uk/media/178231/leicester-l2-sfra-final-report-2012.pdf>.

The Leicester City Council Local Flood Risk Management Strategy (2015) can be accessed directly from: <http://www.leicester.gov.uk/media/178225/master-lfrms-web-lo-res-mar-2015.pdf>.

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), but should be recorded here so that they can be reviewed in the future.

### 5.5 Proposed Major Developments

The current LCC Local Development Framework Adopted Core Strategy<sup>21</sup> identifies that 25,600 new houses are required between 2006 and 2026<sup>22</sup>. Therefore, there are a number of proposed major developments within the City that include strategic development and regeneration areas. The specific flood risks to some of these areas were addressed in the Leicester Strategic Flood Risk Assessment<sup>23</sup> (SFRA) in 2012 in accordance with NPPF PPG. However, these developments can increase the quantity of surface water run off from the developments.

In addition to development within Leicester City, a number of strategic Major Development Areas (sMDAs) are proposed in neighbouring LA areas. The Level 2 SFRA considered the flood risk posed to and from the sMDAs:

- Ashton Green (Leicester City Council),
- New Lubbethorpe (Blaby District Council),
- East of Thurmaston (Charnwood Borough Council),
- Anstey/Glenfield (Charnwood Borough Council), and
- Harborough (Harborough District).

These areas are still under review for the next phase of Leicester City Council's Local Plan.

As the sMDAs are in neighbouring LA areas, it is vital that the Lead Local Flood Authority Board works in partnership with neighbouring authorities.

<sup>21</sup> Leicester City Local Development Framework - Adopted Core Strategy, November 2010

<sup>22</sup> Leicester City Council are currently drafting their new Local Development Plan, due for publication in late 2017.

<sup>23</sup> URS (February 2012) Leicester City Council, Level 2 Strategic Flood Risk Assessment. Available at: <https://www.leicester.gov.uk/media/178231/leicester-l2-sfra-final-report-2012.pdf>.

## 6. Review of Indicative Flood Risk Areas

### 6.1 Overview

The areas that have been identified using a combination of two methodologies. Firstly, a cluster analysis whereby, the “blue squares” were identified wherever at least 200 people or 20 non-residential properties or more than one key service might be flooded. Secondly and finally, the Office for National Statistics, built-up areas (BUAs) has analysed surface water risk. BUAs include areas of built-up land with a minimum of 20 hectares (200,000m<sup>2</sup>). Any areas with less than 200 metres between them are linked to become a single BUA, with built-up area sub-divisions (BUASDs). Where available, the Environment Agency have used BUASDs to provide greater granularity of communities in large urban areas. Where this approach identifies 3000 or more reportable properties at risk of surface water flooding, the BUA/BUASD forms an indicative FRA.

Using this guidance, the Environment Agency has applied it to identify Indicative Flood Risk Areas across the country.

The area of Leicester has been identified as an Indicative Flood Risk Area. For the Humber basin, the Leicester Principal Urban Area (PUA) was one of three Indicative Flood Risk Areas identified. It must be noted that the designated area also covers hydrologically linked areas of adjoining administrative areas which are separate Lead Local Flood Authorities. Due to the hydrological linkage, the Indicative Flood Risk Area cannot be easily split and therefore it is important that a cross boundary and collaborative approach is taken to managing local flood risk as local issues can often stem from a wider catchment issue. The current DEFRA guidance is being reviewed as of 2016, therefore these assumptions are still current for this cycle of PFRA's.

### 6.2 Review of Indicative Flood Risk Area

As discussed in the previous section, the proposed Flood Risk Area also covers a large part of the other neighbouring Councils which are not part of Leicester City Council's administrative area but form part of the drainage catchment and the larger PUA. These include Charnwood Borough Council, Blaby District Council and Harborough District Council and due to the hydrological linkage, the Indicative Flood Risk Area cannot be easily split, therefore it is important that a cross boundary and collaborative approach is taken to managing local flood risk in Leicester.

Based on the 1 km<sup>2</sup> grid and the currently available locally agreed surface water dataset, the Environment Agency uFMfSW, the Indicative Flood Risk Area appears to give a fair representation of flood risk in Leicester City.

## 7. Identification of Flood Risk Areas

LCC has reviewed the latest indicative Flood Risk Area provided by the Environment Agency against other flooding information received and do not propose to increase the size of the indicative Flood Risk Area. The indicative Flood Risk Area is illustrated in Appendix A, Figure A5 and detailed within Annex 3 of the Preliminary Assessment Spreadsheet (see Appendix C).

The indicative Flood Risk Area covers hydrologically linked areas of neighbouring authorities that include critical infrastructure and properties at risk of flooding. Therefore it is important that a cross boundary and collaborative approach with Leicester County Council is taken to managing local flood risk in Leicester.

As discussed in Section 5, a SWMP was completed for Leicester in 2012 that identified flood risk hotspots based on critical drainage areas. The outputs were reviewed by the Lead Local Authority Flood Board and key stakeholders and it was concluded that these verify the indicative FRAs selected in the PFRA. The outputs from this study were used to support and inform the next stages of the requirements of the Flood Risk Regulations, including production of the Leicester FRMS.

## 8. Next Steps

### 8.1 Future Data Management Arrangements

In order to continue to fulfil their role as LLFA, LCC is required to investigate future flood events and ensure continued collection, assessment and storage of flood risk data and information.

However, it is crucial that all records of flood events are documented consistently and in accordance with the INSPIRE Directive (2007/2/EC). It is recommended that the centralised database will continue to be kept up to date by LCC, who has the overall responsibility to manage flood data through the whole administrative area of Leicester City. This can then be used as an evidence base to inform future assessments and reviews and for input into the mapping and planning stages.

Leicester City Councils 'Report A Flood' webpage can be accessed directly from here: <http://www.leicester.gov.uk/transport-and-streets/roads-and-pavements/>. This tool has evidently increased the quantity of recorded flooding incidents across the city. This approach overall, has allowed the City Council to collate a large, mature database in accordance with the INSPIRE Directive (2007/2/EC). Leicester City Council will continue to collect and access flood records to inform future PFRA cycles.

LCC's internal spreadsheet with no personal data contains the following headings: Event date, road name, location (town) and extent of flooding. This database will continue to be developed throughout the second PFRA cycle to build a detailed historical flooding record within the city.

### 8.2 Scrutiny and Review Procedures

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

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

#### 8.2.1 Local Authority Review

The first part of the review procedure is through an internal Lead Local Flood Authority Board review of the PFRA Update, in accordance with appropriate internal review procedures. Internal review should be undertaken to ensure the PFRA Update meets the required quality standards, before it is submitted to the Environment Agency.

#### 8.2.2 Environment Agency Review

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

In 2011, the Environment Agency undertook a technical review (area review and national review) of the original PFRA, which focused on instances where FRAs were recommended for amendment (such as was the case with the Leicester indicative FRA). They then ensured the format of these areas met the provided standard. Satisfied with the proposed amendment to the Leicester indicative FRA, they recommended submission of the PFRA to the relevant Regional Flood and Coastal Committee (RFCC) for endorsement. RFCCs made effective use of their local expertise and ensure consistency at a regional scale. Once the RFCC endorsed the Leicester PFRA, the relevant Environment Agency Regional Director signed it off, before all PFRA's were collated, published and submitted to the European Commission.

The Environment Agency has a role to review, collate and publish the outputs from PFRA. However, the Environment Agency have previously advised that LCC publish the PFRA on their website where it can be linked to from the Environment Agency website. The original PFRA produced in 2011 can be found at the following link:

<https://www.leicester.gov.uk/your-environment/flooding-and-severe-weather/flood-risk-studies/>

or direct here:

<https://www.leicester.gov.uk/media/178227/leicester-city-pfra-september-2011.pdf>

This first review cycle of the PFRA is now being led by LCC, and the PFRA Update must be submitted to the Environment Agency by the 22<sup>nd</sup> of June 2017. They will then submit it to the European Commission by the 22<sup>nd</sup> of December 2017 using the same review procedure described above.

### 8.3 Prepare Flood Risk and Flood Hazard Maps

Part 3 of The Regulations state that LLFAs within indicative Flood Risk Areas were required to prepare Flood Risk and Flood Hazard mapping for each Flood Risk Area by the 22<sup>nd</sup> December 2013. LCC subsequently produced Flood Risk and Flood Hazard Maps between the original 2011 PFRA cycle and this review of the first cycle. The information within this PFRA Update will inform the decision as to whether any new updated Flood Risk and Flood Hazard Maps will need to be produced across the next 6 year cycle.

### 8.4 Prepare Flood Risk Management Plans

Part 4 of Regulations state that LLFAs must prepare flood risk management plans for each Flood Risk Area by the 22<sup>nd</sup> December 2015. The SWMP produced for LCC in 2012 formed the first step towards forming a Flood Risk Management Plan for Leicester. A Local Flood Risk Management Strategy and Plan was subsequently produced by LCC in March 2015. The information within this PFRA Update will inform the decision as to whether a new updated Flood Risk Management Plan will need to be produced across the next 6 year cycle.

### 8.5 Prepare the Next Cycle of the Preliminary Flood Risk Assessment

Section 17 of the Flood Risk Regulations state that LLFAs must carry out subsequent reviews every 6 years. Following the UK Referendum on June 23<sup>rd</sup> 2016, the necessity for a further update to the PFRA will depend upon the outcome of the EU Exit. Further information will be distributed to Leicester City Council when this becomes available.

## **Appendix A – PFRA Maps**

- A.1 Leicester City Council Historical Flooding Incidents (2011-2017)
- A.2 updated Flood Map for Surface Water (uFMfSW) (1 in 100 year event)
- A.3 SWMP Pluvial Model Outputs 0.5% AEP (1 in 200 year event)
- A.4 Areas Susceptible to Groundwater Flooding
- A.5 Indicative Flood Risk Area and Places Above Threshold



## Appendix B – Self-Assessment Form

## **Appendix C – Preliminary Assessment Report Spreadsheet Annexes**

- C.1 Annex 1 – Records of past floods and their significant consequences
- C.2 Annex 2 – Records of future floods and their consequences
- C.3 Annex 3 – Records of Flood Risk Areas and their rationale

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