PRELIMINARY FLOOD RISK ASSESSMENT

DRAIN LONDON

LONDON BOROUGH OF HARINGEY

GREATER**LONDON**AUTHORITY

Thames Water

LONDON COUNCILS

Environment Agency

Haringey Council

Revision Schedule

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RELATED DOCUMENTS

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    - London Borough of Tower Hamlets
- The Environment Agency
- The Greater London Authority
- London Councils
- The London Fire Brigade
- Network Rail
- Thames Water
- Transport for London and London Underground

Executive Summary

Background

This report has been prepared for the London Borough of Haringey primarily to deliver the first step of the Flood Risk Regulations (2009). The London Borough of Haringey is defined as a Lead Local Flood Authority (LLFA) under the Floods and Water Management Act (the Act). The first step of the Flood Risk Regulations is for LLFAs to produce a Preliminary Flood Risk Assessment (PFRA), comprising this document, the supporting spreadsheet and GIS layer. PFRAs were already required prior to the implementation of the Act by the EU Flood Risk Management Regulations ('Floods Directive') and are therefore not a new requirement. The timetable for production of PFRAs and subsequent documents and strategies is defined by the Floods Directive. Some of the information within this report will also assist the London Borough of Haringey to manage local flood risk, in accordance with their duties under the Flood and Water Management Act 2010 (the Act).

The PFRA process is aimed at providing a high level overview of flood risk from all sources within a local area, including consideration of surface water, groundwater, ordinary watercourses and canals. As a LLFA, the London Borough of Haringey is required to submit their PFRA to the Environment Agency for review by 22nd June 2011. This PFRA has been produced as part of a co-ordinated programme of work across greater London facilitated by the Drain London Forum and the GLA. The methodology for producing this PFRA is consistent with other London Boroughs and has been based on the Environment Agency's Final PFRA Guidance and Defra's Guidance on selecting Flood Risk Areas, both published in December 2010.

Indicative Flood Risk Areas

Prior to the development of PFRAs the Environment Agency has used a national methodology, which has been set out by Defra, to identify broad indicative Flood Risk Areas across England where flooding could result in 'significant harmful consequences'. Of the ten indicative Flood Risk Areas that have been identified nationally, one is the Greater London administrative area. The London Borough of Haringey is within this Flood Risk Area.

To date significant harmful consequences have been assessed at a national scale based on a set of National Indicators developed by Defra:

- Human health – 30,000 people or 150 critical services (e.g. schools, hospitals, etc);
- Economic activity – 3,000 non-residential businesses; and
- Impact on environmental designations, heritage and pollution.

Haringey is only one part of the Greater London Indicative Flood Risk Area that met this threshold. Currently there is little guidance available on how national indicators should be applied at the local level and it is expected LLFAs develop their own relevant thresholds based on these indicators.

Review of Indicative Flood Risk Areas

Information relating to past flood events, caused by flooding from local sources, was collected and analysed. However, comprehensive details on flood extents and consequences of these events were largely unavailable. Based on the evidence that was collected, no past flood events could be determined with any certainty to have had 'significant harmful consequences'. Therefore, the decision was made to not include any records of past flooding in Annex 1 of the Preliminary Assessment Spreadsheet.

In order to develop a clear overall understanding of the flood risk across the London Borough of Haringey, flood risk data and records of historic flooding were collected from local and national sources including within the Borough, the Environment Agency, Thames Water, emergency services and other risk management authorities such as TfL.

Examination of the data collected found that there is a high future risk of flooding from local sources in parts of Haringey, particularly from surface water. This high risk relates to the number of people living in areas which may be subject to surface water flooding and not necessarily the frequency of the flood risk. The Drain London project is delivering surface water management plans for each London borough,

including hydraulic modeling of surface water runoff. Based on Drain London outputs it is estimated that approximately 38,800 properties are potentially at risk from flooding during a rainfall event with a 1 in 200 annual chance of occurring. The number of properties and businesses at risk for a future flood event is estimated to have 'significant harmful consequences' at a local scale as has been included in Annex 2 of the Preliminary Assessment Spreadsheet for collation and review by the Greater London Authority and Environment Agency for the Greater London Flood Risk Area.

Following on from approval of this PFRA, the Flood Risk Regulations require the borough to carry out two subsequent key stages:

- Flood hazard maps and flood risk maps (by June 2013); and
- Flood risk management plans (by June 2015).

The next cycle of the Flood Risk Regulations will begin in 2017 with review and update of this PFRA.

Glossary

Term	Definition
Aquifer	A water bearing rock, sand or gravel capable of yielding significant quantities of water.
Asset Management Plan (AMP)	In the context of water services, a plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.
AStSWF	Areas Susceptible to Surface Water Flooding – The first generation broadscale national mapping of surface water flooding prepared for the Environment Agency.
Catchment Flood Management Plan (CFMP)	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
Civil Contingencies Act 2004	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances including flooding.
CLG	Government Department for Communities and Local Government
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Critical Drainage Area (CDA)	Areas of significant flood risk, characterised by the amount of surface runoff that drains into the area, the topography and hydraulic conditions of the pathway (e.g. sewer, river system), and the receptors (people, properties and infrastructure) that may be affected.
Culvert	A buried or underground channel or pipe that carries a watercourse below the level of the ground.
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model – three dimensional digital representation of unfiltered topography surface of an area.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 10 years.
DTM	Digital Terrain Model – three-dimensional digital representation of a bare earth surface (i.e. with buildings, trees removed)
EA	Environment Agency – Who's play a central role on delivering the environmental priorities of central government and the Welsh Assembly Government through functions and roles
Indicative Flood Risk Areas	Areas determined by the Environment Agency as potentially having a significant level of flood risk, based on guidance published by Defra and WAG and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs.
FMfSW	Flood Map for Surface Water – second generation mapping prepared for the Environment Agency on the risk of surface water flooding
Flood defence	Infrastructure used to protect an area against floods. For example, floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.
Flood Risk Regulations (FRR)	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood and Water Management Act	An Act of Parliament passed into law in 2010 which forms part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, a major recommendation of which is to clarify the legislative framework for managing surface water flood risk in England.

Term	Definition
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a river or stream.
IDB	Internal Drainage Board - Internal Drainage Boards (IDBs) are independent bodies responsible for land drainage in areas of special drainage
IUD	Integrated Urban Drainage
LB	London Borough
LDF	Local Development Framework
Lead Local Flood Authority	Local Authority responsible for taking the lead on local flood risk management
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
Local Resilience Forum	A multi-agency forum, bringing together all the organisations that have a duty to cooperate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a co-ordinated manner.
LPA	Local Planning Authority
LRF	Local Resilience Forum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NRD	National Receptor Dataset – a collection of risk receptors produced by the Environment Agency
Ordinary Watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, IDBs
Partner	A person or organisation with responsibility for the decision or actions that need to be taken.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial Flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow.
PPS25	Planning and Policy Statement 25: Development and Flood Risk
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority (RMA)	As defined by the Floods and Water Management Act
River Basin District (RBD)	A River Basin or Basins used for both strategic planning and reporting to the European Commission for the Water Framework Directive. There are eleven RBDs in England and Wales.
Sewer Flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.

Term	Definition
Surface Water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
SWMP	Surface Water Management Plan
TfL	Transport for London
TWUL	Thames Water Utilities Ltd
WaSC	Water and Sewerage Company

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1 Introduction

1.1 What is a Preliminary Flood Risk Assessment?

1.1.1 A Preliminary Flood Risk Assessment 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 and future (potential) floods, assembling the information into a Preliminary Flood Risk Assessment report, and identifying Flood Risk Areas.

1.1.2 This preliminary flood assessment ***report*** for London Borough of Haringey 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 by the process, but new analysis of existing information may be needed.

1.1.3 This PFRA has been based on existing and readily available information and brings together information from a number of available sources such as the Environment Agency's national information (for example Flood Map for Surface Water) and existing local products such as Strategic Flood Risk Assessments (SFRAs) and Surface Water Management Plans (SWMPs).

1.1.4 The scope of the PFRA is to consider past flooding and potential future flooding from the sources of flooding other than main rivers, the sea and reservoirs. In particular this includes surface runoff, groundwater and ordinary watercourses and any interaction these have with other sources of flooding.

1.1.5 The key deliverables from the PFRA process are:

- PFRA Report - This document and associated appendices
- PFRA Spreadsheet – A structured spreadsheet provided by the Environment Agency and populated with information relating to local flooding. It contains the following sections:
  - Annex 1: Records of past floods and their significant consequences
  - Annex 2: Records of future floods and their consequences
  - Annex 3: Records of Flood Risk Areas and their rationale
- PFRA Checklist – A checklist completed by the Lead Local Flood Authority to ensure all aspects of the PFRA process have been covered (included as Appendix D of this document)
- GIS layer of Flood Risk Area(s) – Only required where new Flood Risk Areas are proposed or indicative Flood Risk Areas are amended.

1.2 Background

1.2.1 The primary driver behind the Preliminary Flood Risk Assessment is the Flood Risk Regulations 2009, which came into force on the 10th December 2009 and transpose the EU Floods Directive (Directive 2007/60/EC on the assessment and management of flood risks) into domestic law in England and Wales and to implement its provisions.

1.2.2 In particular the Regulations place duties on the Environment Agency and Local Lead Flood Authorities to prepare a number of documents across an ongoing 6-year cycle including:

- Preliminary Flood Risk Assessments – deadline 22/06/2011
- Flood hazard and flood risk maps – deadline 22/06/2013
- Flood Risk Management Plans – deadline 22/06/2015

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

1.2.4 The scope of the PFRA is to consider past flooding and potential future flooding from the sources of flooding other than main rivers, the sea and reservoirs. In particular this includes surface runoff, groundwater and ordinary watercourses and any interaction these have with drainage systems other sources

1.3 Objectives

1.3.1 The key objectives of the PFRA are summarised as follows:

- Collect information on past (historic) and future (potential) floods within the study area and record it within the Preliminary Flood Risk Assessment spreadsheet;
- Assemble the information into a Preliminary Flood Risk Assessment report;
- Review the Indicative Flood Risk Areas delineating by the Environment Agency and where necessary provide explanation and justification for any amendments required to the Indicative Flood Risk Areas;
- Provide a summary of the systems used for data sharing and storing and the provision for quality assurance, security and data licensing arrangements;
- Describe arrangements for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information;
- Identify relevant partner organisations involved in future assessment of flood risk; and summarise means for future and ongoing stakeholder engagement;
- Provide a useful reference point for all local flood risk management and inform future local strategies.

1.4 Study Area

1.4.1 The London Borough of Haringey is located in north London bordering the London boroughs of Waltham Forest to the east, Camden, Islington and Hackney to the south, Barnet to the west, and Enfield to the north.

1.4.2 The most notable watercourses running through the Borough are the River Lee and the Moselle Brook. The Moselle Brook flows through the north of the Borough in Tottenham and was originally a tributary of the River Lee. The majority of the watercourse is now culverted and flows into the Pymmes Brook. The River Lee flows in a southerly direction along the eastern boundary of the Borough with Waltham Forest.

1.4.3 The topography of the London Borough of Haringey generally slopes in an easterly direction towards the River Lee. The highest parts of the Borough are in the west, along the boundaries with the London Boroughs of Barnet, Camden and Islington, where ground elevations are typically above 90mAOD. The lowest parts of the Borough are along the boundary with Waltham Forest where ground elevations are in the order of 10mAOD. The topography of the borough suggests that surface water runoff is likely to flow in an easterly direction and pond in the low-lying areas. There are a number of railway embankments within the borough that may impede or alter flow routes.

1.4.4 The London Borough Haringey lies within the London Basin, which has been shaped by a relatively thick (few hundred metres) chalk syncline. The basin has been infilled over time by a series of clays and sands, the most notable deposit being the fossil rich and impermeable London Clay. The clay layer can be up to a maximum of 150m thick beneath London. More recently in geological terms, the London Clay has been overlain by drift deposits from river terraces. As the River Lee has altered path and scoured channels deeper through time, they have left deposits of sand and gravel in terrace formations upon the underlying geology. Rainfall in clay areas runs off quickly into the rivers as water is unable to penetrate into the ground. The interaction between groundwater and surface water is generally prevented due to the presence of London Clay.

1.4.5 The study area falls into the Thames River Basin District (RBD) (as defined by the Environment Agency) and is located in the Environment Agency Thames Region (regional operating area). The water utility provider is Thames Water Utilities Ltd.

2 LLFA Responsibilities

2.1 Legislative Background

2.1.1 The key drivers behind the Preliminary Flood Risk Assessment are two pieces of new legislation, the Flood Risk Regulations 2009 which came into force on the 10th December 2009, and the Flood & Water Management Act (FWMA) which gained Royal Assent on the 8th April 2010.

2.1.2 The Flood Risk Regulations 2009 was created to transpose the EU 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.

2.1.3 The Flood and Water Management Act 2010 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.

2.1.4 Under these pieces of legislation, all Unitary Authorities are designated 'Local Lead Flood Authorities' (LLFA) and have formally been allocated a number of key responsibilities with respect to local flood risk management.

2.2 Leadership & Partnership

2.2.1 The Flood and Water Management Act 2010 defines the Lead Local Flood Authority (LLFA) for an area as the unitary authority for the area, in this case London Borough of Haringey. As such, the London Borough of Haringey is responsible for leading local flood risk management including establishing effective partnerships with stakeholders such as the Environment Agency, Thames Water Utilities Ltd, Transport for London, Network Rail and London Underground as well as others. Ideally these working arrangements should be formalised to ensure clear lines of communication, mutual co-operation and management through the provision of Level of Service Agreements (LoSA) or Memorandums of Understanding (MoU).

2.2.2 The London Borough of Haringey forms part of the 'Group 4' group of boroughs, established as part of the Drain London programme, formed to assist delivery of Drain London, but also to establish an ongoing working partnership for managing local flood risk in the area. Drain London Group 4 includes the London boroughs of:

- Enfield
- Hackney
- Haringey
- Newham
- Tower Hamlets
- Waltham Forest

Group 4 are represented on the Thames Regional Flood Defence Committee (RFDC) by the councillor from the London Borough of Enfield.

2.3 Stakeholder Engagement

2.3.1 As part of the PFRA and parallel preparation of the SWMP for the area, Capita Symonds with Scott Wilson on behalf of the London Borough of Haringey, have sought to engage stakeholders representing the following organisations and authorities.

- Environment Agency
- Thames Water Utilities Ltd
- Neighbouring London Boroughs
- British Waterways
- London Fire Brigade
- Network Rail
- London Underground
- Transport for London
- Highways Agency
- Natural England

2.3.2 Of these organisations, the Environment Agency and London Borough of Haringey representatives were actively engaged and assisted in the preparation of this document.

2.3.3 Within London Borough of Haringey, representatives from a number of departments and sectors have been engaged in the PFRA process including Emergency Planning, Strategic Planning, Highways and Sustainable Transport.

2.4 Public Engagement

2.4.1 Members of the public may also have valuable information to contribute to the PFRA and to an improved understanding and management of local flood risk within the study area. Public engagement can afford 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.

2.4.2 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.

2.4.3 It is important to undertake some public engagement when formulating local flood risk management plans, following the designation of Flood Risk Areas within the study area as this will help to inform future levels of public engagement. As part of the Drain London project, the Greater London Authority are reviewing how the project outputs generated could be communicated to the public and will provide advice to boroughs.

2.4.4 It is recommended that the London Borough of Haringey follow the guidelines outlined in the Environment Agency's "Building Trust with Communities" which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums.

2.5 Other Responsibilities

2.5.1 Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for Local Lead Flood Authorities

from the Flood & Water Management Act 2010, and the Flood Risk Regulations 2009. 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.
- **SuDS Approving Body** – LLFAs are designated the SuDS Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new sustainable drainage systems (SuDS) within their area. This responsibility is anticipated to commence from April 2012.
- **Flood risk management strategies** – LLFAs are required to develop, maintain, apply and monitor a strategy for local 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 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 have powers to designate structures and features that affect flooding in order to safeguard assets that are relied upon for flood risk management.

3 Methodology & Data Review

3.1 Data Sources & Availability

3.1.1 Table 3-1 provides a summary of the data sources held by partner organisations and provides a description of the dataset and its availability at the time the PFRA was produced. This data was collated centrally by the Greater London Authority through the Drain London project, including centralising relevant data sharing agreements and licencing. This data was then disseminated to consultants Capita Symonds with Scott Wilson for the preparation of the London Borough of Haringey PFRA.

Table 3-1 Data Sources

	Dataset	Description
Environment Agency	Environment Agency Flood Map (Flood Zones)	Shows extent of flooding from rivers with a catchment during 1 in 100yr flood and 1 in 1000yr flood. Shows extent of flooding from the sea during 1 in 200yr and 1 in 1000yr flood events. Ignores the presence of defences.
	Areas Susceptible to Surface Water Flooding	A national outline of surface water flooding held by the EA and developed in response to Pitt recommendations.
	Flood Map for Surface Water	A second generation of surface water flood mapping which was released at the end of 2010.
	Groundwater Flooding Incidents	Records of historic incidents of groundwater flooding as recorded by the Environment Agency.
	National Receptors Dataset	A nationally consistent dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations.
	Indicative Flood Risk Areas	National mapping highlighting key flood risk areas, based on the definition of 'significant' flood risk agreed with the Defra and WAG.
	Historic Flood Outline	Attributed spatial flood extent data for flooding from all sources.
	Rainfall Data	15 minute and daily rainfall gauge records from approximately 1990 – 2010 for gauge sites across London.
	Source protection zones	Show the risk of contamination that might cause pollution in the area. The maps show three main zones (inner, outer and total catchment).
	Asset data	Details on the location and extent of flood defences across Group 4 as well as a system asset management plans.
London Borough	Strategic Flood Risk Assessments (SFRA)	SFRAs may contain useful information on historic flooding, including local sources of flooding from surface water, groundwater and flooding from canals.
	Historical flooding records	Historical records of flooding from surface water, groundwater and ordinary watercourses.
	Anecdotal information relating to local flood history and flood risk areas	Anecdotal information from authority members regarding areas known to be susceptible to flooding from excessive surface water, groundwater or flooding from ordinary watercourses.

	Highways Flooding Reports	Highways Flooding Reports, including analysis of the flood risk at each location.
Thames Water	DG5 Register for Thames Water Utilities areas	DG5 Register logs and records of sewer flooding incidents in each area.
	Sewer pipe network	GIS dataset providing the georeferenced location of surface water, foul and combined sewers across Group 4. Includes pipe size and some information on invert levels.
British Waterways	British Waterway's canal network	Detailed GIS information on the British Waterway's canal network, including the location of canal centrelines, sluices, locks, culverts, etc.
	Records of canal breaches and overtopping events	Records of historical canal overtopping and drainage misconnections.
British Geological Society	Geological datasets	Licenced GIS datasets including: • Geological indicators of flooding; • Susceptibility to groundwater flooding; • Permeability; • Bedrock and superficial geology.
GLA	Deprived Areas	Index of Multiple Deprivation, ranking all London Ward's.
London Fire Brigade	Historic flooding records	London Fire Brigade call outs to incidents of flooding between January 2000-December 2009. Does not specify the source of flooding.
London Underground and Network Rail	Historic flooding records	Recorded incidents of flooding to London Underground and National Rail infrastructure

3.2 Limitations

Records of Past Floods

3.2.1 The most significant data gap across the London Borough of Haringey relates to records of past 'local' flooding incidents. This is a common issue across the UK as record keeping of past floods has historically focussed on flooding from rivers or the sea. Records of past incidents of surface water, sewer, groundwater or ordinary watercourse flooding has been inconsistent.

3.2.2 Thames Water have provided post code-linked data (DG5 register) on records of sewer flooding, however more detailed data on the location and cause of sewer flooding is not currently available.

3.2.3 Similarly, the London Fire Brigade have recorded incidents of call outs relates to flooding, however there is no information on the source of flooding (e.g. many may be pipe bursts), or probability, hazard or consequence of the flooding.

Future Groundwater Flooding

3.2.4 Groundwater flooding is dependent on local variations in topography, geology and soils. The causes of groundwater flooding are generally understood however it is difficult to predict the actual location, timing and extent of groundwater flooding without comprehensive datasets.

3.2.5 There is a lack of reliable measured datasets to undertake flood frequency analysis and even with datasets this analysis is complicated due to the non-independence of groundwater level data. Surface water flooding incidents are sometimes mistaken for groundwater flooding incidents, e.g. where runoff via infiltration seeps from an embankment, rather than locally high groundwater levels.

Future Surface Water Flooding

3.2.6 The Environment Agency data sets 'Areas Susceptible to Surface Water Flooding' and second generation 'Flood Map for Surface Water' are national scale assessments suitable for broadly identifying surface water flood risk. The datasets are of a resolution suitable for the PFRA, however are limited in their use in addressing the next stages of the Flood Risk Regulations (2009), e.g. Hazard Maps. The outputs from Drain London will assist in addressing this data limitation.

Flooding Consequences

3.2.7 The analyses to prepare the indicative Flood Risk Areas issued to accompany the final PFRA Guidance were based on the National Receptors Database (NRD) version 1.0 (for the counts of properties and other receptors). Receptor information was prepared for all London Boroughs in December 2010 in order to undertake property counts required for the SWMPs, also using NRD version 1.0. Version 1.1 of the NRD has subsequently been issued and contains modifications and corrections since version 1.0. However, in order to avoid repetition of work, and ensure consistency between the SWMP and the PFRA, it was decided to complete the PFRA using NRD version 1.0.

3.3 Security, Licensing and Use Restrictions

3.3.1 A number of datasets used in the preparation of this PFRA are subject to licensing agreements and use restrictions.

3.3.2 The following national datasets provided by the Environment Agency are available to lead local flood authorities for local decision making:

- EA Flood Zone Map
- Areas Susceptible to Surface Water Flooding
- Flood Map for Surface Water
- National Receptor Database

3.3.3 A number of the data sources used are publicly available documents, such as:

- Strategic Flood Risk Assessment
- Catchment Flood Management Plan

- Surface Water Management Plan

3.3.4 The use of some of the datasets made available for this PFRA has been restricted. These include:

- Records of property flooding held by the Council and by Thames Water Utilities Ltd;
- British Geological Society geology datasets;
- London Fire Brigade call outs for flooding;

3.3.5 Necessary precautions must be taken to ensure that all information given to third parties is treated as confidential. 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.

3.4 Quality Assurance

3.4.1 The datasets used to inform this PFRA were collected centrally for all London Boroughs as part of the Tier 1 Drain London work package. All data received was subject to quality assurance measures to monitor and record the quality and accuracy of the data and information. A data quality score was given to all the data which is a qualitative assessment based on the Data Quality System provided in the SWMP Technical Guidance (March 2010). This system is explained in Table 3-2.

Table 3-2 Data Quality System (SWMP Technical Guidance March 2010)

Data Quality Score	Description	Explanations	Example
1	Best available	No better available; not possible to improve in the near future	2D Pluvial Modelling Outputs
2	Data with known deficiencies	Best replaced as soon as new data is available	Historic Flood Records
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	Impact of a historic flood event

3.4.2 The use of this system provides a basis for analysing and monitoring the quality of data that is being collected and used in the preparation of the PFRA. As mentioned in Section 3.2, some of the datasets collected for this PFRA were of poor quality, and this has been identified and recorded using this system.

3.4.3 Details of the data used in the assessment for the London Borough of Haringey and their classified scores has been provided in the Haringey SWMP.

4 Past Flood Risk

4.1 Summary of Past Floods

4.1.1 Table 4-1 provides a summary of the past flooding recorded in more than one location in London Borough of Haringey, and known to be from surface water, sewer or groundwater sources. Records in Table 4.1 are based on the reoccurrence of reported incidents in an area, however as identified in Section 3.2, it does not necessarily represent every flooding incident in the London Borough of Haringey.

Table 4-1 Past Floods & Consequences

Date	Main source of flooding	Description	Data Source	Significant harmful consequences?
Unknown	Pluvial/Fluvial	Flooding near to Turnpike Lane	LB Haringey	No
Unknown	Pluvial/Fluvial	Flooding near to Downhills Way (B155)	LB Haringey	No
03/10/2002 and 17/03/2009	Groundwater	Flooding reported in Highgate along Hampstead Lane and Southwood Lane	EA	No
09/12/2002 and 04/04/2005	Groundwater	Flooding in Tottenham Hale: Lansdowne Road and Shelbourne Road.	EA	No
14/11/2003 and 25/06/2007	Groundwater	Seepage and standing water reported along The Avenue, Tottenham	EA	No
21/06/2005 and 22/11/2007	Groundwater	Flooding near to Coniston Road, Muswell Hill	EA	No

4.1.2 The complete record of known and recorded flooding incidents in the London Borough of Haringey are shown on the following figures in Appendix A:

- A-1 Surface Water Flooding Incidents
- A-2 Main River / Fluvial / Tidal Flooding Incidents
- A-3 Groundwater Flooding Incidents
- A-4 Sewer Flooding Incidents

4.2 Significant Harmful Consequences

4.2.1 There is very little reliable information available on the consequences of each of the flood events in Table 4.1, therefore there is no certainty in being able to classify them as having “significant harmful consequences”, as required by the Flood Risk Regulations. In the absence of any reliable data, the London Borough of Haringey believes none of these events meet the criteria to be included in Annex 1 of the PFRA.

4.2.2 Available data on historic flooding in the London Borough of Haringey has been assembled into a standardised GIS data record as part of the Drain London project to assist with consistent

and suitably detailed recording of future flooding incidents for the next cycle of the Flood Risk Regulations.

4.3 Interactions with Other Flooding Sources

4.3.1 Flooding is often the result of water from more than one source, or water building up because another source (such as a river, or the sea) has prevented it from discharging normally. Information about past flooding can often be from an unknown source (i.e. it is not clear where the water came from), or flooding as a result of interactions between sources (in which case more than one source may be recorded).

4.3.2 Where flood records within the study area are known to be from more than one flood source, this has been recorded in the Preliminary Flood Risk Assessment spreadsheet. Where the source of flooding is not known this has also been recorded.

5 Future Flood Risk

5.1 Summary of Future Flood Risk

5.1.1 Information about future flood risk, or potential flooding, is usually produced by computer models. The Environment Agency has several national datasets showing risk of flooding from surface water, groundwater and main rivers and ordinary watercourses that are available to LLFAs:

- Areas Susceptible to Surface Water Flooding (AStSWF);
- EA Flood Map for Surface Water (FMfSW);
- Areas Susceptible to Groundwater Flooding; and
- EA Flood Zone Map

5.2 Locally Agreed Surface Water Information on Future Flood Risk

Surface Water and Ordinary Watercourses

5.2.1 In addition to these national datasets more locally specific surface water information is available for the study area. The London Borough of Haringey is in the process of completing a Surface Water Management Plan (SWMP) as part of the Drain London project. As part of this study, direct rainfall modelling has been undertaken to simulate surface water flooding in the study area and is presented as mapping in the SWMP. In accordance with the PFRA guidance (2010), this mapping represents the locally agreed surface water information for Haringey.

5.2.2 Figures B-1 and B-2 included in Appendix B show the results from this modelling for the 1 in 100 year return period rainfall event. Figure B-1 shows the Maximum Flood Depth and Figure B-2 shows the Flood Hazard Rating and general Flow Direction. Figures B-3 and B-4 show the same outputs for the 1 in 200 year return period rainfall event.

5.2.3 For a full methodology, the reader is referred to the Surface Water Management Plan for London Borough of Haringey. For details on the significant consequences of the identified flooding refer to Annex 2.

5.2.4 The direct rainfall modelling undertaken for Drain London represents an improvement on the existing national data sets (e.g. Flood Map for Surface Water) and has therefore been used as the primary dataset to determine the significance of flooding from surface water and ordinary watercourses.

Groundwater - Increased Potential for Elevated Groundwater (iPEG) Mapping

Background

5.2.5 Large areas within the Drain London area are underlain by permeable substrate and thereby have the potential to store groundwater. Under some circumstances groundwater levels can rise and cause flooding problems in subsurface structures or at the ground surface. The mapping technique described below aims to identify only those areas in which there is the greatest potential for this to happen and in which there is the highest possible confidence in the assessment.

5.2.6 The following four data sources have been utilised to produce the increased Potential for Elevated Groundwater map:

- British Geological Survey (BGS) Groundwater Flood Susceptibility Map;
- Jacobs Groundwater Emergence Maps (GEMs);
- Jeremy Benn Associates (JBA) Groundwater Flood Map; and
- Environment Agency/Jacobs Thames Estuary 2100 (TE2100) groundwater hazard maps.

5.2.7 To produce the iPEG map for consolidated aquifers, an area was defined as having increased potential for elevated groundwater levels if at least two of the three mapping techniques listed above produced a corresponding area. For the permeable superficial deposits, only Band 1 Very High of the BGS and the TE2100 data were used as this was judged to best represent the hazard.

5.2.8 The techniques used to generate the iPEG map produced some small areas of increased potential and some dry islands within increased potential areas. These have not been cleaned in order to best represent the original data.

How to Use and Interpret the Map

5.2.9 The increased Potential for Elevated Groundwater map shows those areas within the Borough where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or be within 2 m of the ground surface.

5.2.10 Groundwater may become elevated by a number of means:

- Above average rainfall for a number of months in Chalk outcrop areas;
- Shorter period of above average rainfall in permeable superficial deposits;
- Permeable superficial deposits in hydraulic continuity with high water levels in the river;
- Interruption of groundwater flow paths; and
- Cessation of groundwater abstraction causing groundwater rebound.

5.2.11 With the exception of groundwater rebound which is not covered, the iPEG map will identify those areas most prone to the mechanisms described above. The map shows those areas considered to have the greatest potential for elevated groundwater. Additional areas within the London Boroughs have permeable geology and therefore could also produce elevated groundwater levels. However, to produce a realistic map, only where there is the highest degree of confidence in the assessment are the areas delineated. This ensures resources are focused on the most susceptible areas. In all areas underlain by permeable substrate, groundwater should still be considered in planning developments.

5.2.12 Within the areas delineated, the local rise of groundwater will be heavily controlled by local geological features and artificial influences (e.g. structures or conduits) which cannot currently be represented. This localised nature of groundwater flooding compared with, say, fluvial flooding suggests that interpretation of the map should similarly be different. The map shows the area within which groundwater has the potential to emerge but it is unlikely to emerge uniformly or in sufficient volume to fill the topography to the implied level. Instead, groundwater emerging at the surface may simply runoff to pond in lower areas. The localised nature of groundwater flooding and the different interpretation of the maps required is illustrated in the cartoon in Figure 5-1.

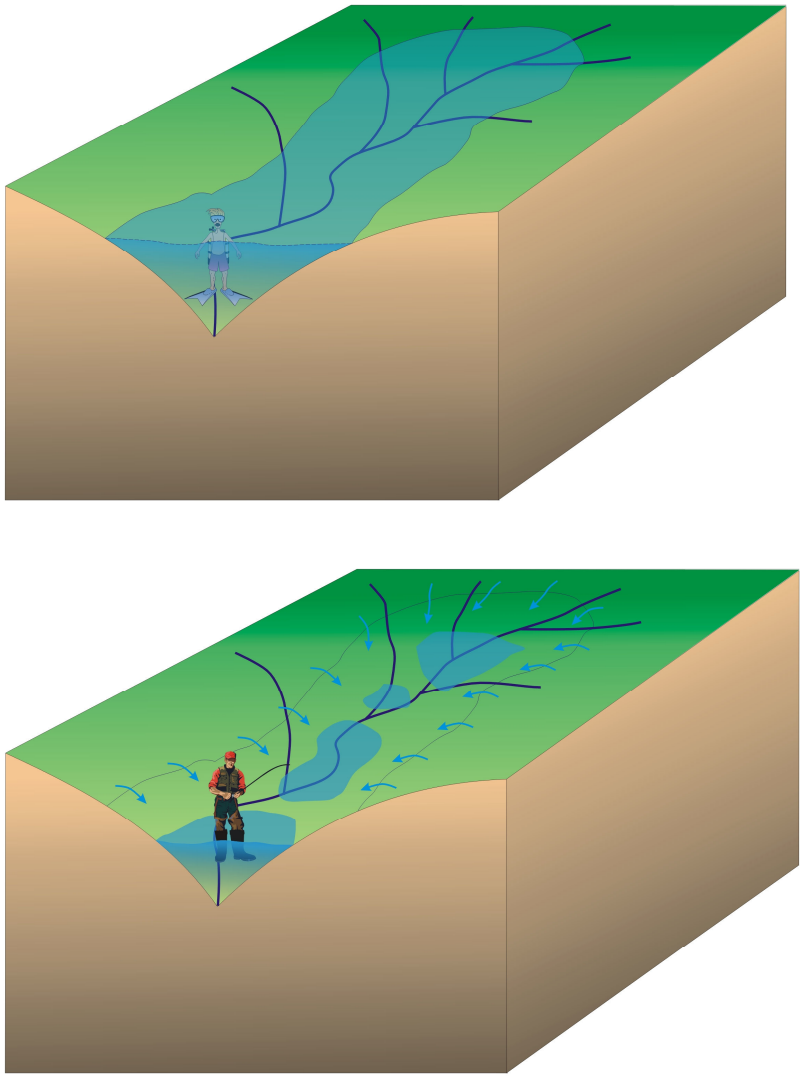

Figure 5-1 Cartoon illustrating the difference between fluvial (top image) and groundwater (bottom image) flood mapping.

5.2.13 For this reason within iPEG areas, locations shown to be at risk of surface water flooding are also likely to be most at risk of runoff/ponding caused by groundwater flooding. Therefore the iPEG map should not be used as a "flood outline" within which properties at risk can be counted. Rather it is provided, in conjunction with the surface water mapping, to identify those areas where groundwater may emerge and if so what would be the major flow pathways that water would take.

Results

5.2.14 The iPEG mapping is presented in Appendix A, Figure A-5. The mapping shows an increased potential for ground water to rise most noticeably in the north-eastern corner of the borough in the vicinity of the Pymmes Brook and Tottenham Hotspurs Football Club. Elsewhere, small scattered areas are identified as having an increased potential and are predominately located in the eastern half of the borough apart from an area near Alexandra Park in Wood Green. In

contrast, historic records of groundwater incidents are scattered throughout the London Borough of Haringey. Furthermore, the density of past events appears to be distributed evenly across the borough and is not noticeably inclined to the east. The discrepancy between recorded historic incidents and potential areas of future incidents may be attributed to the following:

- Past incidents may be a result of localised flooding mechanisms (or other flooding mechanisms) which have not been assessed as part of the production of the iPEG mapping.
- The flood source attributed to past incidents may not be accurate.
- The iPEG mapping does not represent local geological features and artificial influences (e.g. structures or conduits) which have the potential to heavily influence the local rise of groundwater.
- The iPEG map only shows areas that have the greatest potential for elevated groundwater and does not necessarily include all areas that are underlain with permeable geology.

Table 5-1 Summary of Potential Future Floods and Consequences from Pluvial/ordinary Watercourses

Main source of flooding	Probability	Description	Data Source	No. Flooded Properties				
				Households	Infrastructure	Commercial/ Industrial	Other	Total
Pluvial/ ordinary watercourses	1 in 30	• 'Intermediate Assessment' in accordance with Defra Guidance. Topography is derived from LIDAR (in larger urban areas, on 1m, 2m grids; original accuracy ± 0.15m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. 100mm upstand created for all buildings (above average ground level) to represent floor levels and preferential flow around buildings. • Flow routes dictated by topography; 6.5mm/hr of the rainfall applied to the model is removed to account for drainage (Thames Water guidance), however the drainage has not been explicitly modelled. • Areas that may flood are defined by dynamically routing a 3 hour duration storm with 1 in 30 chance of occurring in any year, over the DTM using Tuflow 2D hydrodynamic modelling software. Model run for double duration to enable assessment of runoff through catchments. • Varying Manning's n applied to landuse based on OS Mastermap data to represent variable 'roughness' of different landuses. Varying runoff coefficients to represent variable runoff from different landuses (e.g. parkland vs buildings) • River flood defences and other key structures that will significantly affect local flood mechanisms are included (e.g. transportation tunnels). • Flood depth less than 100mm filtered from results so areas of most significant flooding are clear.	Drain London direct rainfall modelling	28,700	240	2,060	1,600	32,600
	1 in 75			31,350	260	1,600	2,290	35,500
	1 in 100			32,100	270	1,630	2,400	36,400
	1 in 100 (plus climate change)			34,400	300	1,800	2,600	39,100
	1 in 200			34,200	300	1,800	2,500	38,800

5.2.15 Information on the probability and consequences of future sewer flooding, based on detailed modelling of the sewer network, is not available for this PFRA.

5.3 Impact of Climate Change

5.3.1 There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

5.3.2 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.

5.3.3 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.

5.3.4 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%.

5.3.5 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%

Implications for Flood Risk

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

5.3.7 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.

5.3.8 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.

5.3.9 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.

5.3.10 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.

5.3.11 The pluvial modelling completed for the Surface Water Management Plan for London Borough of Haringey included a model scenario with an allowance for climate change over the next 100 years by increasing rainfall intensity by 30%.

5.4 Major Developments

5.4.1 The Core Strategy for the London Borough of Haringey identifies growth areas in:

- Wood Green; and
- Tottenham Hale

5.4.2 In each instance an Area Action Plan will be produced to provide further guidance on how development should be brought forward.

5.4.3 In the case of the Wood Green identified growth area, development offers the opportunity to reduce flood risk in 'critical drainage areas' identified in the Surface Water Management Plan. Regeneration allows for consideration of flood resilient design and construction, locating of new developments in suitable areas, and the limiting of local runoff which may in turn reduce the probability and depth of flooding to areas downstream.

5.5 Long Term Developments

Adapting to Change

5.5.1 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.

5.5.2 Although the broad climate change picture is clear, we have to make local decisions against deeper uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

Long Term Developments

5.5.3 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.

5.5.4 In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

5.5.5 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 The London Borough of Haringey within their draft “Sustainable Design and Construction Supplementary Planning Document” (LB Haringey, January 2011) have outlined how new developments could become more resilient to the effects of climate change. The document does not create new policy, however aims to clarify the implementation of national, regional and local policies. The document promotes the use of measures such as SUDs and green spaces to minimise flood risk. The report has currently undergone consultation and will be submitted to Cabinet for Adoption on 19th July 2011.

6 Review of Indicative Flood Risk Areas

6.1 Extent of Flood Risk Areas

6.1.1 Appendix C shows the Indicative Flood Risk Areas that have been identified by the Environment Agency. Greater London, and the entirety of the London Borough of Haringey is shown to be included in an Indicative Flood Risk Area.

7 Next Steps

7.1 Scrutiny & Review

As the Lead Local Flood Authority, London Borough of Haringey is required to review and approve this PFRA in accordance with their own internal processes. The process chosen by the London Borough of Haringey is review of the PFRA by Heads of Department, such as Sustainable Transport, Planning and Development, and Emergency Planning and Business Continuity.

7.2 Data Collection & Management

7.2.1 As identified in Section 3.2, a number of data gaps have been identified that limit the capacity to accurately summarise the risk of flooding in the London Borough of Haringey from 'local' sources.

7.2.2 Key activities that could assist with addressing these gaps prior to the next round of PFRAs (expected in 2016):

- Investigation and recording of significant past flooding incidents (as discussed below);
- Refining of the Drain London direct rainfall modelling in critical drainage areas to improve the understanding of flood mechanisms and flood hazard, and therefore whether the consequences of future flooding in these areas should be classified as significant;
- Work in partnership with flood risk management organisations (e.g. Thames Water and the Environment Agency) to refine and share information on groundwater flooding and sewer flooding;

7.3 Incident Recording

7.3.1 The London Borough of Haringey propose to implement a system for recording local flood incidents across the borough. Where notification is given by the public, or other body, regarding flooding these will be recorded in a database provided through the Drain London project and containing existing records of past flooding in the London Borough of Haringey.

7.4 Other FRR Requirements

7.4.1 In accordance with the Flood Risk Regulations, the London Borough of Haringey will prepare Flood Hazard and Flood Risk Maps for Flood Risk Areas, followed by a Flood Management Plan. The Surface Water Management Plan currently being prepared for the London Borough of Haringey is expected to deliver many of the other requirements in the first cycle of the Flood Risk Regulations.

7.4.2 Once guidance on Flood Hazard Mapping and Flood Risk Management Plans is issued, the London Borough of Haringey will review its Surface Water Management Plan to determine compliance and any further work required.

7.4.3 The next cycle of preparing PFRAs will begin in 2017.

8 References

Environment Agency, December 2010, Preliminary Flood Risk Assessment (PFRA) Final Guidance, Report GEHO1210BTGH-E-E

Environment Agency, December 2010, Preliminary Flood Risk Assessment (PFRA) Annexes to the Final Guidance, Report GEHO1210BTHF-E-E

Defra (2006) Flood and Coastal Defence Appraisal Guidance, FCDPAG3 Economic Appraisal, Supplementary Note to Operating Authorities – Climate Change Impacts October 2006. http://www.defra.gov.uk/environment/flooding/documents/policy/guidance/fcdpag/fcd3climate.pdf

Capita Symonds Ltd, 2011, Surface Water Management Plan (Draft) for London Borough of Haringey

LB Haringey, May 2010, Haringey Core Strategy: Proposed Submission

LB Haringey, January 2011,

Appendix A Past Floods

Appendix B Future Floods

Figure B-1 Maximum Flood Depth – 1 in 200yr Rainfall Event

Figure B-2 Flood Hazard & Flow Direction – 1 in 200yr Rainfall Event

Figure B-3 Maximum Flood Depth – 1 in 100yr Rainfall Event plus Climate Change

Figure B-4 Flood Hazard & Flow Direction – 1 in 100yr Rainfall Event plus Climate Change

Appendix C Flood Risk Areas

Appendix D Review Checklist

Appendix E GIS Layer of Flood Risk Area(s)

Provided to the Drain London board for a pan-London submission to the Environment Agency