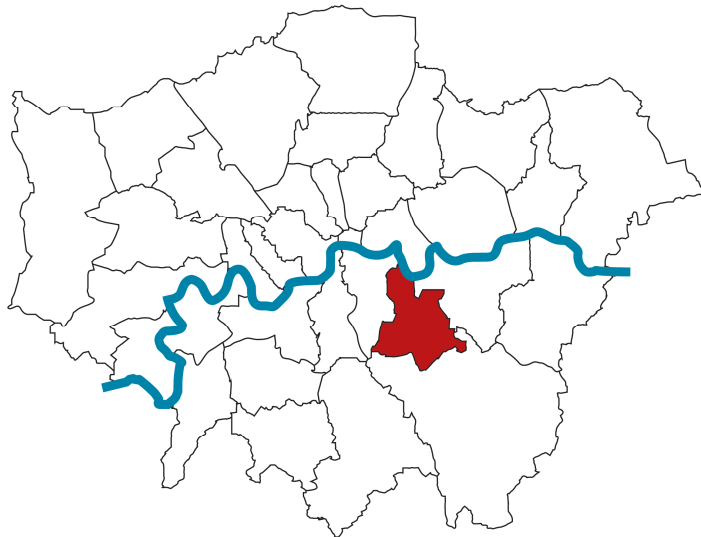


PRELIMINARY FLOOD RISK ASSESSMENT



DRAIN LONDON

**LONDON
BOROUGH OF
LEWISHAM**

GREATER **LONDON** AUTHORITY



Document Information

Title:	Preliminary Flood Risk Assessment for London Borough of Lewisham
Owner:	Bob Quatresols
Version:	0.4
Status:	Final Draft
Project Number:	WUDLSW
File Name:	PFRA_Halcrow_Report_for_Lewisham_v0.4

REVISION HISTORY

Summary of Changes	Completed by	Date of Issue	Version
Draft version	Bruno Venturini/Helen Winter	11/03/2011	0.1
Number of properties at risk updated	Helen Winter	25/03/2011	0.2
Final Draft	Bruno Venturini/Helen Winter	13/04/2011	0.3
Updated flooded property counts	Helen Winter	18/04/2011	0.4

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RELATED DOCUMENTS

Doc Ref	Document Title	Author	Date of Issue	Version
SWMP	Surface Water Management Plan for London Borough of Bromley	To be completed	April 2011	Draft

Acknowledgments

We would like to thank the following for their contribution to this report:

Bob Quatresols, Champion for London Borough of Lewisham

Trevor Odell, Flood Risk Management, Environment Agency

Ivan Parr, Flood Risk Mapping & Data Management Technical Specialist, Environment Agency

Robert Smith, Champion for London Borough of Bexley

Alistair Berry, Champion for London Borough of Bromley

Jeff Horsman, Champion for London Borough of Greenwich

Johanna Gibbons, Design Advisors for the Central London Green Grid, J & L Gibbons LLP

Executive Summary

The Preliminary Flood Risk Assessment report forms part of the wider Drain London project, which involves the delivery of Surface Water Management Plans (SWMP) and Preliminary Flood Risk Assessments (PFRA) for each of the thirty three London Boroughs. The PFRA has been undertaken to assist the London Borough of Lewisham to meet its duties as a Lead Local Flood Authority, with the delivery of the first stage of the Flood Risk Regulations (2009). These regulations implement the EU Floods Directive in the UK.

The PFRA is a high level screening exercise that compiles information on significant local flood risk (any flood risk that does not originate from main rivers, the sea or large reservoirs) from past and future floods, based on readily available and derivable information. The PFRA also includes the identification of flood risk areas where the subsequent two stages of the Flood Risk Regulations apply; stage two delivers Flood Risk Maps and stage three delivers Flood Risk Management Plans.

This study has not identified any past floods that are considered to have had significant harmful consequences. This is based on the following local definition of harmful consequences: 'Memorable past floods or otherwise registered on a national scale (such as the summer 2007 event) even if only occurring over a relatively small area.'

Future flood risk is estimated to be high in the borough. Based on the Drain London surface modelling outputs, approximately 21,500 properties are estimated to be at risk from flooding during an extreme rainfall event (similar to the 2007 storm event in Hull) with a 1 in 200 annual chance of occurring.

The indicative flood risk areas provided by the Environment Agency have been reviewed based on the local knowledge of past and future floods. The outcome of this review is that the indicative flood risk areas can be used as the flood risk areas, for the undertaking of stages three and four of the regulations.

Glossary

Term	Definition
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
AMP	Asset Management Plan
Asset Management Plan	A plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.
AStSWF	Areas Susceptible to Surface Water Flooding
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CDA	Critical Drainage Area
Critical Drainage Area	A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances including flooding.
CLG	Government Department for Communities and Local Government
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Culvert	A channel or pipe that carries water below the level of the ground.
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
DTM	Digital Terrain Model
EA	Environment Agency

Term	Definition
Indicative Flood Risk Areas	Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and WAG and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs.
FMfSW	Flood Map for Surface Water
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRR	Flood Risk Regulations
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
LB	London Borough
LDF	Local Development Framework
LFRZ	Local Flood Risk Zone
Local Flood Risk Zone	Local Flood Risk Zones are defined as discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location
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.

Term	Definition
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
PA	Policy Area
Policy Area	One or more Critical Drainage Areas linked together to provide a planning policy tool for the end users. Primarily defined on a hydrological basis, but can also accommodate geological concerns where these significantly influence the implementation of SuDS
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority	As defined by the Floods and Water Management Act
RMA	Risk Management Authority
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment

Term	Definition
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.
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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1.0 Introduction

1.1 What is a Preliminary Flood Risk Assessment?

The PFRA is a high level screening exercise that compiles information on significant local flood risk from past and future floods, based on readily available and derivable information.

Local flood risk is defined as flood risk originating from sources other than main rivers, the sea and large reservoirs and principally meaning flood risk from surface runoff, groundwater and ordinary watercourses. This main definition of local flood risk requires further clarification: a) it includes lakes and ponds, b) it does not consider flooding from sewers unless this is wholly or partly caused by rainwater or other precipitation entering or otherwise affecting the system, c) it does not include flooding from water supply systems (for example burst water mains) and d) it considers the interaction with flooding from main rivers, the sea and sewers.

The main scope of this report is to summarise the work undertaken to comply with Part 2 of the Flood Risk Regulations 2009 (see **Table 1** in **Section 1.3** below and the following link: <http://www.legislation.gov.uk/ukxi/2009/3042/contents/made>).

1.2 Background

This study for the London Borough of Lewisham forms part of the wider Drain London project, which is a wider initiative that involves the undertaking of Surface Water Management Plans and Preliminary Flood Risk Assessments for each of the thirty three London Boroughs.

Halcrow Group Ltd is undertaking the SWMP and PFRA for the London boroughs of Bexley, Bromley, Lewisham and Greenwich (Group 6) and for the London boroughs of Camden, Hammersmith & Fulham, City of London, Islington, Kensington & Chelsea and Westminster (Group 3). Other consultants are concurrently undertaking SWMP and PFRA for the other London Boroughs and as part of the same Drain London project working group.

1.3 Objectives

The main aim of this study was to undertake Part 2 of the Flood Risk Regulations (FRR) 2009.

The timescales for undertaking Parts 2, 3 and 4 of the FRR 2009 are summarised in **Table 1** below.

Table 1 – Main requirements of the Flood Risk Regulations 2009 for LLFAs

<i>FRR 2009 ref.</i>	Description
<i>Part 2</i>	LLFAs to undertake PFRAs on local flood risk by 22 June 2011 , within their administrative boundaries. LLFAs or groups of LLFAs to confirm or to propose alternative Flood Risk Areas from indicative flood risk areas already identified in national datasets by 22 June 2011 .
<i>Part 3</i>	LLFAs to prepare Flood Hazard and Flood Risk Maps by 22 June 2013 for the flood risk areas and in relation to local flood risk.
<i>Part 4</i>	LLFAs to prepare Flood Risk Management Plans of the identified flood risk areas by 22 June 2015 .

Note 1: Part 1 of the FRR relates to the General Provisions of the regulations which provide details of commencement, scope and main definitions.

Note 2: This table does not cover the tasks undertaken by the Environment Agency to comply with the Flood Risk Regulations in relation to flooding from main rivers, the sea and large reservoirs.

Note 3: Parts 3 and 4 have not been undertaken as part of this study.

The key objectives for the PFRA are summarised as follows:

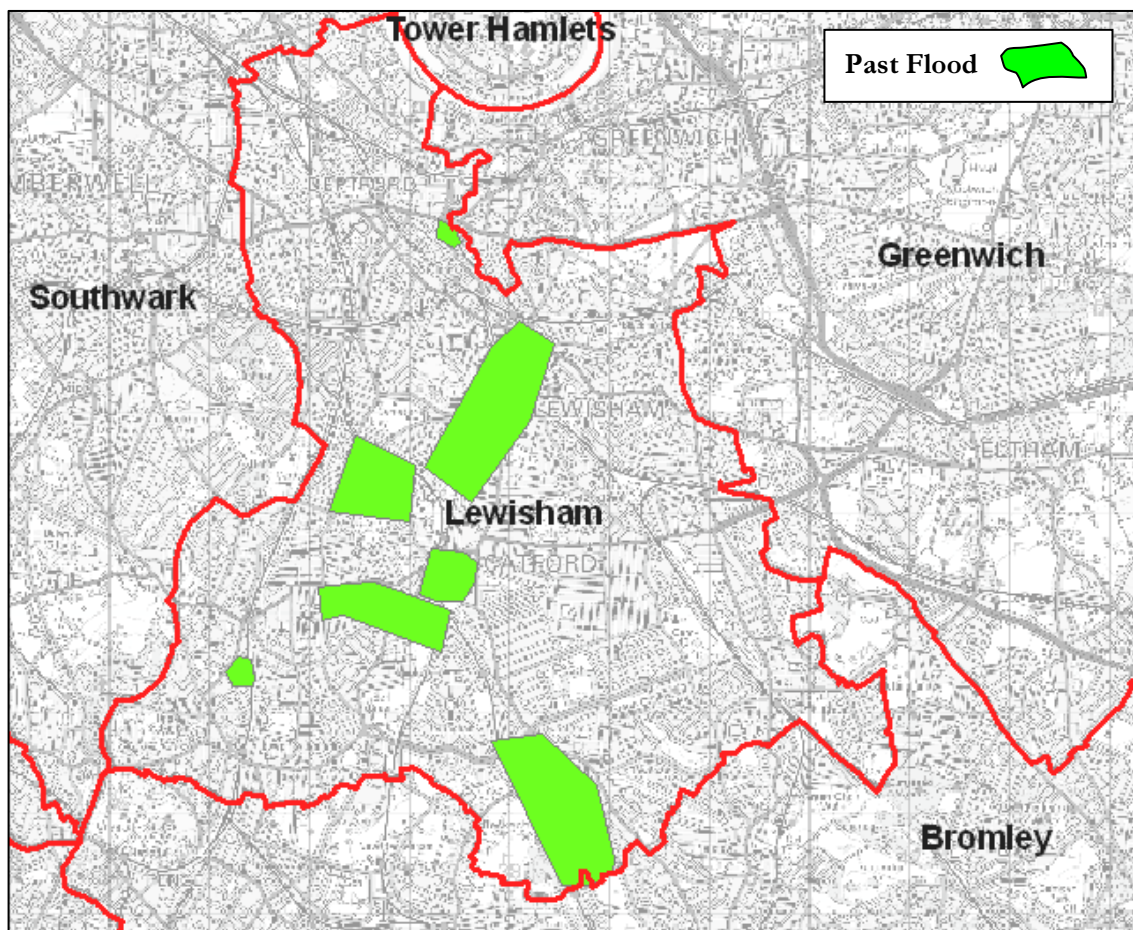
- Identify relevant partner organisations involved in future assessment of flood risk; and summarise means of future and ongoing stakeholder engagement;
- Describe arrangements ongoing collection, assessment and storage of flood risk data and information (see **Section 8.3**);
- Summarise the methodology adopted for the PFRA with respect to data sources, availability and review procedures;
- Assess historic flood events within the study area from local sources of flooding (including flooding from surface water, groundwater and ordinary watercourses), and the consequences and impacts of these events;
- Assess the potential harmful consequences of future flood events within the study area;
- Review the provisional national assessment of indicative Flood Risk Areas provided by the Environment Agency and provide an explanation and justification for any amendments required to the Flood Risk Areas;
- Provide a summary of the systems used for data sharing and storing, and provision for quality assurance, security and data licensing arrangements;
- Provide advice on the next steps required to ensure that the London Borough of Lewisham complies with its role as the LLFA.

1.4

Study Area

The study area covers the administrative boundary of the London Borough of Lewisham. It however needs to take account of interactions with adjacent boroughs and in particular if floods are identified as covering more than one borough. **Figure 1.1** shows the study area and the coverage of past floods. These past floods coincide with Local Flood Risk Zones (LFRZs) which have been identified for the Bexley Surface Water Management Plan (SWMP). More detail on these LFRZs can be found in the completed SWMP.

Figure 1.1 - Study Area and Locations of Past Floods (highlighted in green)

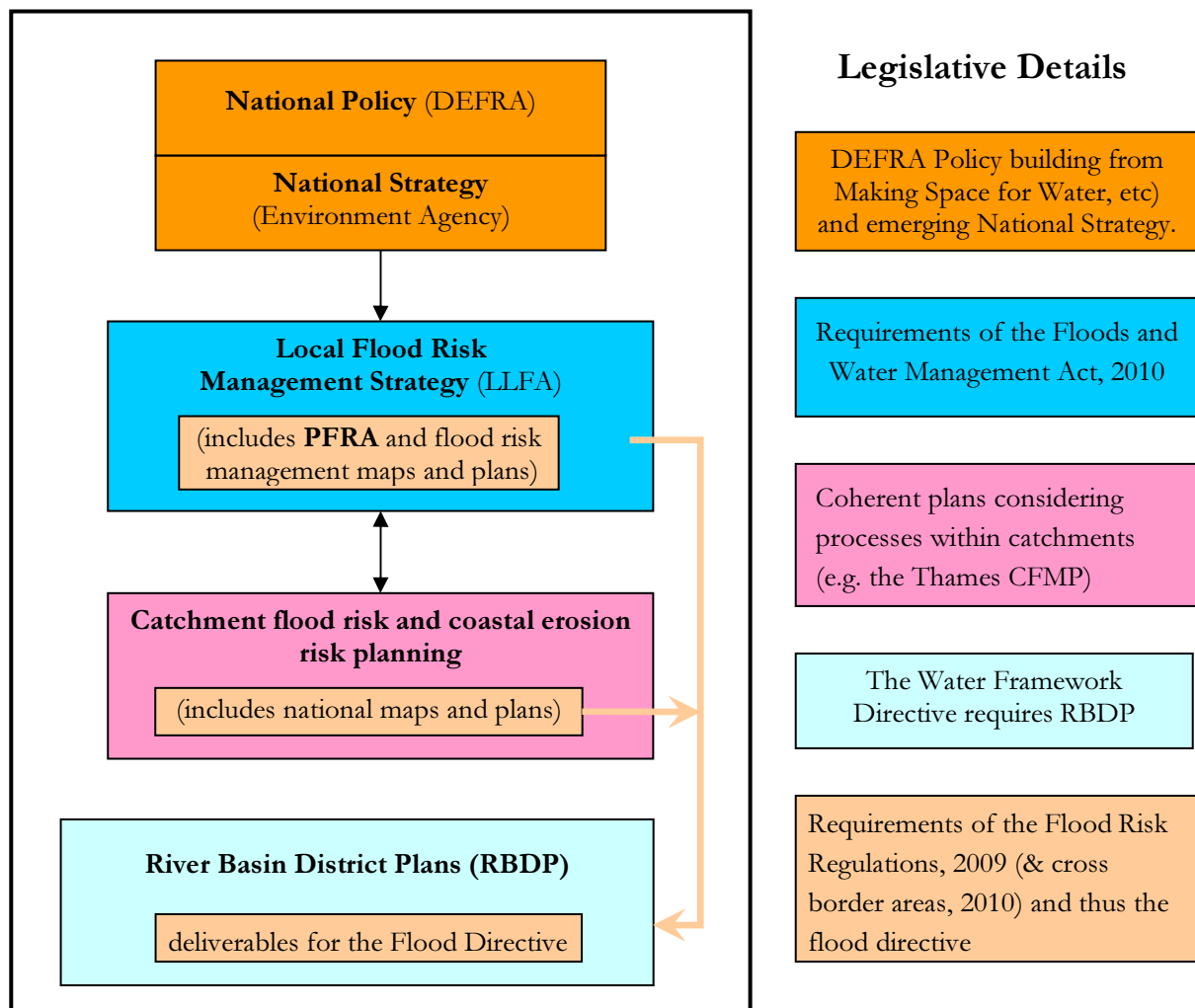


2.0 LLFA Responsibilities

2.1 Legislative Background

The legislative background showing how the PFRA fits within this context is summarised in **Figure 2.1** below.

Figure 2.1 – Legislative Background



CFMP = Catchment Flood Management Plan

The **Floods and Water Management Act** was brought into UK law in 2010 to improve flood risk management and support continuity of water supply. A key feature of the Act is the implementation of recommendations from the Pitt Review into the summer 2007 flooding, thus increasing the emphasis on sources of flooding other than fluvial and tidal, in particular surface water which featured heavily in the 2007 flooding.

The Act gives a number of responsibilities and powers to both the Environment Agency and the Lead Local Flood Authorities. As mentioned in **Section 1.1**, the LLFA are made responsible for local flood risk and main rivers, the sea and large reservoirs are the responsibility of the Environment Agency. The Environment Agency will also be responsible for producing a **National strategy for Flood and Coastal Erosion Risk Management (FCERM)** for England.

The PFRA and SWMP for the London Borough of Lewisham will inform the future Local Flood Risk Management Strategy and the future update of the Strategic Flood Risk Assessment (**SFRA**) and other high level documents, such as the Thames Catchment Flood Management Plan (**CFMP**).

2.2

Leadership and Partnership

As Lead Local Flood Authority, it is the role of the London Borough of Lewisham to forge effective partnerships with the adjacent LLFA and the Environment Agency (this is currently the case with the Drain London project) as well as other key stakeholders – Thames Water, Network Rail, Transport for London and the Highways Agency. Some progress has been made toward establishing these partnerships already, although Network Rail and the Highways Agency have not yet fully engaged with the process. Ideally working arrangements should now be formalised by the LLFA 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).

Figure 2.2 provides a schematic of the recommended partnership and stakeholder arrangements:

Figure 2.2 – Partnership and Main Stakeholder Schematic Diagram



2.3

Stakeholder Engagement

A stakeholder engagement workshop has taken place in March 2011 to clarify roles and responsibilities and to initiate discussions on the way forward for: a) data sharing, b) communication with partners, c) SuDs approval (see **Section 2.5**), d) future approaches to local flood risk and e) public engagement.

In addition to the main partners, the following stakeholders were invited: a) Thames Water, b) Network Rail, c) Transport for London, d) the Highways Agency, e) consultants currently involved in the London Green Grid initiative, f) the fire and rescue service and g) the police service. Those stakeholders that were unable to attend have been provided with details of the outcomes of the workshop and included in subsequent discussions.

2.4

Public Engagement

It is recognised that members of the public may also have valuable information to contribute to future cycles of the PFRA by way of flood incident reporting in the interim period, and to local flood risk management. Stakeholder engagement can be of significant benefit 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.

It is important to undertake some public engagement when formulating local flood risk management plans as this will help to inform future levels of public engagement. It is recommended that the London Borough of Lewisham follow the guidelines outlined in the Environment Agency's 'Building Trust with Communities' document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums.

2.5

Other 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 (Flood Risk Regulations 2009, Part 2, Section 12).
- **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** – The Floods and Water Management Act, 2010 establishes a SuDS Approval Body at county or unitary local authority level (in this case the London Borough of Lewisham) to ensure national standards of sustainable drainage are enforced. Developers will be required to gain approval of their proposed drainage systems before they can begin construction, and the SuDS Approving Body will then be responsible for adopting and maintaining SuDs which serve more than one property (other than on public roads which are the responsibility of the Highways authorities).
- **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 local flood risk, consistent with the local flood risk management strategy for the area.
- **Designation powers** – LLFAs, as well as the Environment Agency have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.

3.0 Methodology and Data Review

3.1 Data Sources

Most of the required data has been made available from the previous stage (Tier 1) of the Drain London project. The key information that was obtained is listed in **Table 3.1** below (a full list of the information is included in the Data Gap and Licensing Report issued by Tier 1 Consultants in October 2010, a copy of which will be provided on project completion):

Table 3.1 – Summary of Key Drain London Tier 1 Data

Source	Data/Studies
Environment Agency	Environment Agency Asset Data; Water Studies (including Thames Catchment Flood Management Plan, Thames Catchment Abstraction Management Strategy and Thames River Basin management Plan; Historic flood data (GIS flood event outlines extracted from NFCDD); Geostore data including Main River details, flood data for areas vulnerable to surface water flooding and Digital River Network (DRN) data for London; Numerous fluvial and surface water models located in the Greater London area; London hydrometric data including groundwater level data, rainfall data and river flow data; and Details of Flood Warning Areas in London
London Borough of Lewisham	SFRA report; Flooding records; GIS data for Critical Infrastructure; Gulley locations.
Thames Water	Foul water and surface water sewer network models in GIS format; Sewer Flooding Incident Records by postcode; Pumping station and manhole locations.
Other (Highways Agency, Transport for London, Network Rail, Local flood groups, fire brigade, etc)	Various assets; Flood records; GIS layers for land use types; BGS Susceptibility to Groundwater Flooding

Additional information has been obtained from the borough through an initial site visit followed by a more detailed virtual site visit/workshop of areas at risk of flooding.

The virtual site visits/workshops have proved to be a highly valuable process which involved ‘virtual walks’ by technical staff from the Environment Agency, borough and Halcrow identifying many local flood risk areas, using a GIS environment and the use of Google Street View for 3D images.

The virtual site visits process involved the overlaying of the following GIS layers: a) OS maps, b) the Thames Water pipe network system, c) the river networks, d) the flood zones, e) groundwater incident records, f) surface water flood incident records, g) local flood risk data from strategic data providers (for example the fire brigade), h) the Environment Agency national Flood Map for Surface Water (FMfSW), h) the Drain London surface water hazard and flood depth maps produced by Halcrow for this borough, e) the SFRA surface water flood depth maps, f) a digital terrain model to identify catchment boundaries and terrain gradients, etc. All this information will be provided on project completion.

The virtual site visits assisted in achieving a number of SWMP and PFRA objectives and these are listed in **Table 3.2** below:

Table 3.2 – Objectives of the Virtual Site Visit

No	Objective	Informs the SWMP	Informs the PFRA
1	Identify the source of flooding of past events (from readily available records)	✓	✓
2	Identify the pathways of past events and better understand the mechanism of flooding	✓	✓
3	Identify the receptors of past events	✓	✓
4	Identify which past events had significant consequences to human health, economic activity and/or the environment	✓ (to a lesser extent)	✓
5	Verify the Drain London surface water map outputs against past events	✓	✓ (to a lesser extent)
6	Compare past events against surface water maps originating from: a) Drain London, b) the SFRA and c) the Environment Agency.	✓ (to a lesser extent)	✓
7	Locally agree surface water information **	✓ (to a lesser extent)	✓
8	Identify the source of flooding of future events (from modelling outputs)	✓	✓
9	Identify the pathways of future events and better understand the mechanism of flooding	✓	✓
10	Identify the receptors of future events	✓ (to a lesser extent)	✓
11	Confirm which future flooding events are considered to be significant, affecting either or a combination of: a) human health, b) economic activity and c) the environment	✓ (to a lesser extent)	✓
12	Consider a number of structural and non structural solutions for each flood risk area	✓	✓ (to a lesser extent)
13	Enhance stakeholder engagement which is considered to be very important for this project	✓	✓

** This is mainly a requirement of the PFRA as more than one modelling output could be available for local flood risk (this is the case for this borough in relation to surface water modelling outputs). It was agreed that the Drain London surface water mapping outputs should be used to inform the PFRA as the outputs better verify past flood events and also because it provides more extended information in relation to flood risk (a range of return period events, flood depth and hazard mapping).

3.2

Availability

All available data were collected from key strategic data providers on behalf of the GLA for Tier 1. Data availability for the Borough of Lewisham was relatively extensive, with flood records and GIS data for infrastructure.

Thames Water has provided data on sewer flooding incidents. This data has been used to correlate patterns of sewer flooding but it has been of limited use due to the limited level of detail Thames Water have been able to release. **Map 4.1a** displays this data by number

of incidents per postcode envelope. Sewer flooding information held by the borough has been included in the assessment of historical flooding.

3.3

Limitations

The data acquired from the strategic providers were all in the required format. The local information provided by the London Borough of Lewisham was in the form of flood incident records in Excel format. This information lacked desirable details such as flood extents.

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.

3.4

Security, Licensing and Use Restrictions

In addition to the individual organisations licensing agreements, the Data gap and licensing Report from the Tier 1 Stage Consultants list three 'Golden rules' applicable under the Drain London framework:

- Any data received for any use in Tier 2 or 3 of the Drain London programme may not, under any circumstances, be provided to any third party or used for any other purpose whatsoever without the explicit written permission of the data provider;
- All rights to the data are reserved by and to the data provider; and
- The right of the data provider to commercially exploit the data must be protected at all times.

Any information provided to the borough or partners have been through highly secure channels and the management plan for the project has clearly specified a unique location for storing the data.

Table 3.3, below, gives an overview of the data restrictions and licensing details for key Drain London Tier 1 data outlined in **Table 3.1**. The full licensing information for the strategic data providers is included in the Data Gap and Licensing Report, October 2010.

Table 3.3 – Data restrictions and licensing details for strategic data providers

Organisation	Restrictions on data and licensing agreements
Environment Agency	The use of some data is restricted to the GLA, Local Authorities and their Consultants. Specific data, such as the Indicative Surface Water Flood Risk Areas, are supplied to the consultants via the Local Authorities, as per the Agency's licensing agreement. This data can only be used for surface water management plans, strategic flood risk assessments of preliminary flood risk assessments.
London Borough of Lewisham	See 'Golden Rules' outlined under <i>section 3.4</i>
Thames Water	<ul style="list-style-type: none"> • 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 • If Thames Water request, the details of any third party to whom information has been disclosed must sign a confidentiality agreement acceptable to Thames Water • Information is provided without a warranty; therefore Thames Water excludes any liability for any inaccuracy or incompleteness of disclosed information
Other (Highways Agency, Transport for London, Network Rail, Local flood groups, fire brigade, etc)	Other organisations hold similar agreements for data supplied to the project. A number of organisations, such as fire brigade and Network Rail have no formal agreement in place.

3.5

Quality Assurance

Data collected were subject to quality assurance measures to monitor and record the quality and accuracy of acquired information and datasets. 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 3.4**.

Table 3.4: Data Quality System from 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	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

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 3.3** the information provided lacked in level of detail (an average data quality score of 2 was given) which was however then improved as part of the virtual site visits. The relevant data and details of the individual quality scores will be provided on project completion.

4.0 Past flood risk

4.1 Summary of Past Floods

This **Chapter** focuses on past floods that had *significant harmful consequences* to human health, the local economy, local environmental sensitive areas and cultural heritage. It also report floods with no *significant harmful consequences*.

Table 4.1 below provides a summary of local past floods, with or without significant harmful consequences (based on Environment Agency guidance), identified by the borough as part of the virtual site visit (see **Section 3.1**) and through historical records. **Map 4.1** provides a visual representation of past floods for different sources of flood risk; it shows flood incident data as well as the past floods listed in **Table 4.1**. The information provided does not include dates when the flood events occurred, as many of these have happened more than once at the same location.

Table 4.1 – Summary of Past Floods

Location	Source of flooding (? Indicated uncertainty)	Description: Source, Pathway and Receptor information and Interactions with Other Flooding Sources	Consequence
Lewisham Town Centre (see extents in Map 4.1)	Surface Water/Fluvial/ Groundwater	The town is at the confluence of rivers and has a high water table. It is also the confluence of railway lines that can act as a conduit to flood water in heavy rainfall. There is lots of development in this area.	Flooding to railways, highways and possibly property.
Deptford, South of A2	Surface Water/ Groundwater/ Fluvial/Tidal	Capacity of this system depends on the maintenance of flap valves to the Thames. There is a lot of flooding in this area and has some associated environmental health problems	Flooding to properties - basements
Beckenham Park	Surface Water/Fluvial	This is a site of a potential flood storage reservoir as part of proposed Lewisham and Catford FAS	Flooding to highways
Upper Honor Oak	Surface Water	Connections to Ladywell Stream	Proposed Lewisham and Catford FAS
Marley Road, Carholme	Surface Water	Sewers under capacity. Thames Water Storage tanks are located in the area and could be used to solve the problem	Flooding to highways and property
Pool Court	Surface Water	Drainage in this area is ineffective and requires further investigation	Flooding to highways
Catford Bridge, Catford	Surface Water/Fluvial/ Groundwater	A combination of a high water table in this area and sewers under capacity contribute to flooding in heavy rainfall	Flooding to basements – namely the theatre

Location	Source of flooding (? Indicated uncertainty)	Description: Source, Pathway and Receptor information and Interactions with Other Flooding Sources	Consequence
Spring Brook	Surface Water/Fluvial	Construction project to be complete by end March 2011 to raise flood defences upstream of A21 within the park	Flooding to highways and possibly property
Hither Green	Fluvial/Surface Water/ Groundwater	It is a low spot in the catchment where surface runoff is constrained by the railway embankment and limited drainage capacity. In July 2007 this area flooded up to 1.3m depth and its average depth was 0.4m under a localised rainfall depth of approximately 40mm.	Flooding to highways

4.2

Significant Harmful Consequences

The London Borough of Lewisham does not have any past floods with *significant harmful consequences* to report to the EU, based on the following definition of significance (based on Environment Agency guidance):

‘Memorable past floods or otherwise registered on a national scale (such as the summer 2007 event) even if only occurring over a relatively small area.’

Annex 1 has therefore no local information to report.

An example that fits with the definition above would be the floods in the summer of 2007. This event was characterised by unusually unsettled weather and above average rainfall through the month of July, peaking on 20 July, when an active frontal system deposited more than 100 millimetres (3.9 in) of rain in parts of England in a 24 hour period. The City of Hull experienced extensive surface water flooding effecting approximately 8700 homes.

The above definition of *significant harmful consequence* has been defined locally by the LLFA and it is based on a recent Environment Agency briefing paper on reporting information on past floods (Feb 2011).

Although there are no past floods to report to the EU, the borough has identified one past flood that is considered to be sufficiently important to be distinguished from other past floods with lesser consequences. This is the past floods at Hither Green (see row highlighted in orange in **Table 4.1** above).

The PFRA guidance requires LLFAs to assess flooding from sewers where it is caused by rainwater or other precipitation entering or otherwise affecting the system. The DG5 register from Thames Water was analysed to investigate the occurrence of sewer flooding incidents in the London Borough of Lewisham (see **Map 4.1a**). It was found that there

were approximately 260 properties flooded from sewer flooding events that have been recorded by Thames Water over the past decade, about 30 of which were severely affected.

4.3**Interactions with Other Flooding Sources**

Interactions with other flooding sources are shown in the description column of **Table 4.1**. Of particular importance is the interaction of surface water flooding with main rivers along the low lying areas in the vicinity of the River Ravensbourne and the River Quaggy and their tributaries. Surface water in this case is heavily influenced by the water levels in the main rivers.

5.0 Future flood risk

5.1 Summary of Future Flood Risk

Future flood risk for extreme events is estimated to be high in the borough as it is anticipated in many highly urbanised areas throughout the country.

Table 5.1 summarises the number of properties at risk of surface water flooding based on the Drain London and the FMfSW model outputs (this information has been copied in **Annex 2** for reporting to the EU).

Table 5.1 – Number of properties at risk of Flooding

Location	Drain London 200 year event	Drain London 30 year event	FMfSW 200 year event
Lewisham	21,500	14,750	37,100

In particular, as no schemes have been undertaken at the locations of past floods, unless identified in **Table 4.1**, all these locations can be considered as areas where similar floods could still occur. Much of the flooding of the locations identified in **Table 4.1** are confirmed by the following modelling outputs: a) as part of the Drain London surface water modelling undertaken, b) surface water modelling undertaken as part of the SFRA and c) from the two Environment Agency national datasets. These national datasets are the Areas Susceptible to Surface Water (ASStSWF) and the Flood Map for Surface Water (FMfSW).

5.2 Locally Agreed Surface Water Information

A comparison of surface water model outputs from the three sources identified in **Section 5.1** was undertaken as part of the virtual workshops. The agreed conclusion was that the surface water modelling outputs (Drain London model outputs) were most representative of the study area. In most cases the Drain London model outputs tied better to the flooded areas identified in past events when compared to the other model outputs.

Maps 5.1 and **5.2** provide information of the 1 in 200 year rainfall event depths and hazard grids respectively.

5.3 Increased Potential for Elevated Groundwater (iPEG) Mapping

5.3.1

Background

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.

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;
- Groundwater Emergence Maps (GEMs);
- Groundwater Flood Map; and
- Environment Agency Thames Estuary 2100 (TE2100) groundwater hazard maps.

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.

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.

5.3.2

How to Use and Interpret the Map

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.

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.

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.

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**.

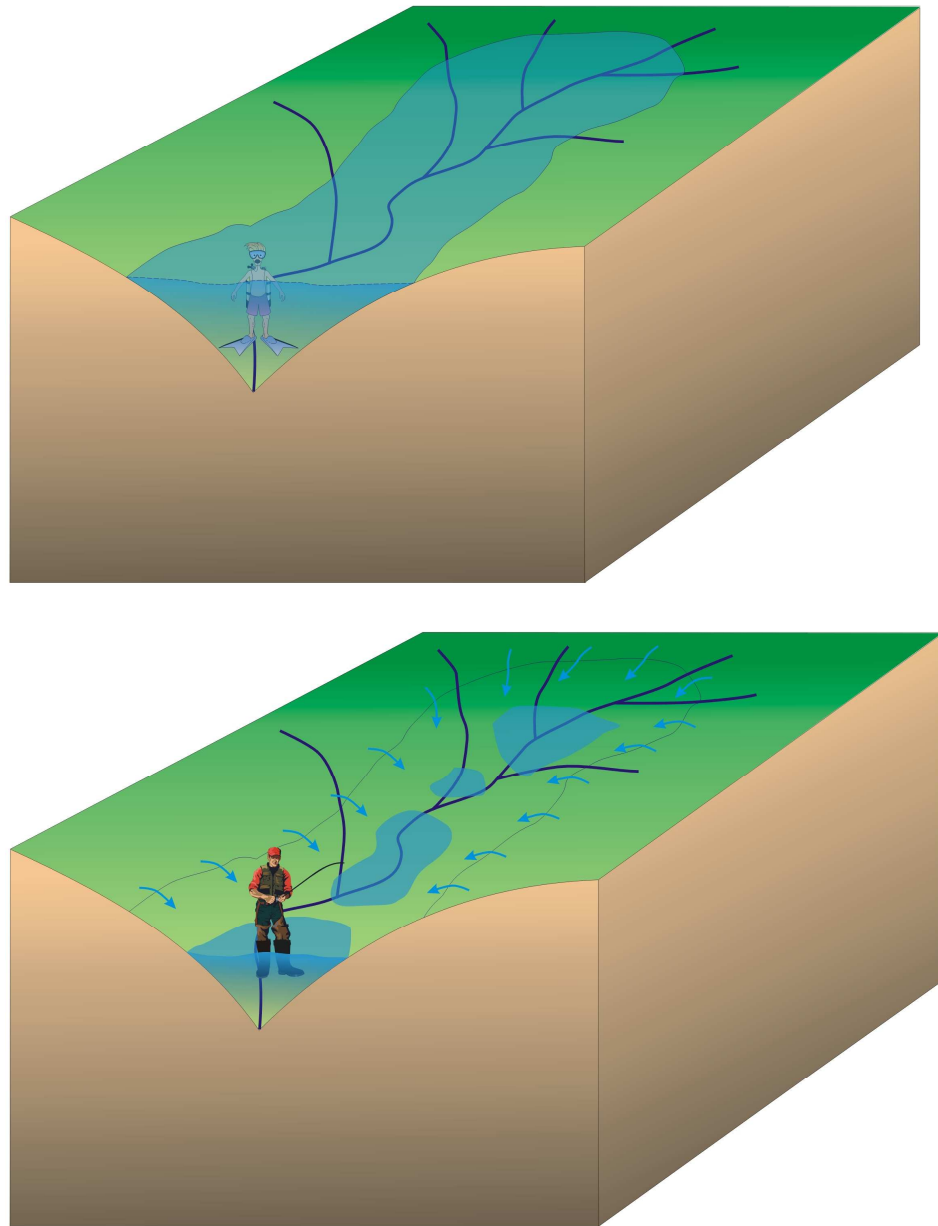


Figure 5.1 Cartoon illustrating the difference between fluvial (top image) and groundwater (bottom image) flood mapping.

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.

5.3.3

Results

The iPEG mapping is presented in **Map 5.3**.

This modelling indicates that elevated groundwater from permeable superficial soils are located in along the centre of the Borough, surrounding the flood plain of the River Ravensbourne. It also shows elevated ground water from consolidated aquifers in the north western corner of the borough around Deptford.

This map has been taken into account when identifying the past and future flood areas.

5.4

Impact of Climate Change

Maps 5.4 and 5.5 provide information of the 1 in 100 year rainfall event, with climate change, depths and hazard grids respectively.

5.4.1

The Evidence

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

Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation; however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future but changes are still projected at least as far ahead as the 2080s.

We have enough confidence in the 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%.

5.4.2

Key Projections for Thames River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are (Environment Agency guidance):

- Winter precipitation increases of around 15% (very likely to be between 2 and 32%)

- Precipitation on the wettest day in the winter up by around 15% (very unlikely to be more than 13%)
- 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 flow in a typical catchment likely to increase between 8 and 18%

Implications for Flood Risk

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

Wetter winters and more of this rain falling in wet spells may increase river flooding in both rural and heavily urbanised catchments. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

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

There is a risk of flooding from groundwater-bearing chalk and limestone aquifers across the district. Recharge may increase in wetter winters, or decrease in drier summers.

Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

5.4.3

Adapting to Change

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

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

5.5**Long Term Developments**

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

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

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria), but should be recorded here so that they can be reviewed in the future.

6.0 Review of Indicative Flood Risk Areas

6.1 Extent of Indicative Flood Risk Areas

The Environment Agency map showing the indicative flood risk areas for the Greater London area is provided in **Map 6.1**.

These have been obtained as a result of adopting a consistent and proportionate approach at national level, taking account of: a) the number of people (based on property numbers x 2.34), b) the number of critical services and c) the number of non-residential properties. The national datasets used were: a) the FMfSW, b) the AStSWF (not in London), c) the National Receptor Database (NRD) and d) the Areas Susceptible to Groundwater Flood Map.

An important principle of the method is that the assessment of significance is based on flooding in the order of a 1 in 100 chance in any given year.

The threshold for the significance criteria is set at 30,000 people at risk of surface water flooding.

6.2 Review Comments

The indicative flood risk areas have been reviewed within the borough area. These areas cover a large number of the past and future floods identified in **Chapters 4 and 5**. This is not surprising as the Drain London surface water maps provide similar however more accurate extents to the FMfSW. There is no reason therefore to believe that there will be additional areas outside the indicative flood risk areas which will reach the national threshold.

7.0 Identification of Flood Risk Areas

7.1 Amendments to FRA

Based on the comments in **Section 6.2** no changes are proposed for the Greater London Indicative Flood Risk Areas. All of the Lewisham is assumed to be within the Greater London Indicative Flood Risk Area.

7.2 New FRA

The new FRA proposed is therefore the same as the Indicative FRA.

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8.0 Next Steps

8.1 Scrutiny and Review

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:

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

The second part of the review procedure is through the Environment Agency. Under the Flood Risk Regulations, the Environment Agency has been given a role in reviewing, collating and publishing all of the PFRAs once submitted. The Environment Agency will undertake a technical review (area review and national review) of the PFRA, which will focus on instances where Flood Risk Areas have been amended and ensure the format of these areas meets the provide standard. If satisfied, they will recommend submission to the relevant Regional Flood Defence Committee (RFDC) for endorsement. RFDCs will make effective use of their local expertise and ensure consistency at a regional scale. Once the RFDC has endorsed the PFRA, the relevant Environment Agency Regional Director will sign it off, before all PFRAs are collated, published and submitted to the European Commission.

The first review cycle of the PFRA will be led by the London Borough of Lewisham and must be submitted to the Environment Agency by the 22nd of June 2011. They will then submit it to the European Commission by the 22nd of December 2011 using the same review procedure described above.

8.2 Data Collection and Management

Data gaps that will require future collection activities are listed as follows:

- 1) A systematic approach to recording local flood risk is recommended, in particular for locations where there are interactions with other sources of flooding and locations where significant hazards have been identified.

There is an opportunity to work with the Environment Agency in developing an integrated system for collecting and managing data, based on the systems that are already in place for fluvial and tidal flooding.

- 2) A better understanding of how the drainage system operates will be gained by obtaining and interrogating the relevant Thames Water models. These models will be critical for the further stages of the SWMP which will also benefit the PFRA.

8.3**Incident Recording**

As part of the Drain London project the LLFA have been provided with a template spreadsheet for the recording of information in a consistent way. This template follows the principles given in the INSPIRE European Directive (these are listed in the final guidance document for PFRA).

8.4**Other Flood Risk Regulation Requirements**

Other planned actions that will be required to comply with the Flood Risk Regulations are:

- 1) Development of an action plan on how the borough will perform its duties as the SuDs approval body (approval, adoption and maintenance of SuDs which serve more than one property).
- 2) Links with Flood Risk Assessments and SuDs approvals to be developed as an integrated approach to the approval of SuDs proposals.

9.0 References

London Borough of Lewisham Strategic Flood Risk Assessment Level-1, (July 2008) at <http://www.lewisham.gov.uk/NR/rdonlyres/E5919E0D-FBA0-4636-AB7D-40553CD6734A/0/StrategicFloodRiskAssessment.pdf>

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Miller, H.L. (eds.). Summary for Policymakers. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 9. Available for download from <http://www.ipcc.ch/ipccreports/ar4-wg1.htm>

The Pitt Review (2008) Learning lessons from the 2007 floods

Annex A – Records of past floods and their significant consequences (Preliminary Assessment Spreadsheet)

Please refer to Annex A of the Preliminary Assessment Spreadsheet which has been supplied alongside this report.

Annex B – Records of future floods and their significant consequences (Preliminary Assessment Spreadsheet)

Please refer to Annex B of the Preliminary Assessment Spreadsheet which has been supplied alongside this report.

Annex C – Records of Flood Risk Area and its rationale (Preliminary Assessment Spreadsheet)

Please refer to Annex C of the Preliminary Assessment Spreadsheet which has been supplied alongside this report.

Annex D – Review Checklist

Please refer to Annex D spreadsheet which has been supplied alongside this report.

Annex E – GIS Layer of Flood Risk Area(s)

Please refer to Annex E GIS layer which has been supplied alongside this report.
This GIS layer is the same as the Environment Agency Indicative Flood Risk Area layer.