



# London Borough of Lewisham Strategic Flood Risk Assessment (SFRA)

July 2008 (Final)



London Borough of Lewisham  
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## EXECUTIVE SUMMARY

1. The London Borough of Lewisham lies to the south east of the centre of London. The Borough fronts onto the River Thames for approximately 1km in the north and extends approximately 8km south from here. It falls within most of the catchment of the River Ravensbourne and its tributaries, which outfalls into the Thames at Deptford Creek. The Borough covers an area of approximately 35 square kilometres and has a population of 248,922 in 107,412 households (2001 Census<sup>1</sup>).
2. It is important to recognise that some of those areas that are at risk of flooding in the Borough are under pressure from future development. It is essential therefore that the Council are in a position to take informed decisions, providing a careful balance between the risk of flooding and other unrelated planning constraints that may place pressure upon 'at risk' areas. The Lewisham Borough SFRA endeavours to provide specific advice to assist the Council in this regard.
3. **This report (and the supporting mapping) represents the Level 1 SFRA<sup>2</sup>, and should be used by the Council to inform the application of the Sequential Test.** Following the application of the Sequential Test, it may be necessary to develop a Level 2 SFRA<sup>3</sup> should it be shown that proposed allocations fall within a flood affected area of the Borough. The Level 2 SFRA should consider the risk of flooding in greater detail within a local context to ensure that the site can be developed in a safe and sustainable manner.

### Outcomes of the Lewisham Borough SFRA

4. The London Borough of Lewisham has been delineated into zones of low, medium and high probability of fluvial and tidal flooding (refer Section 5.1), based largely upon existing available information provided by the Environment Agency. A further assessment of flood hazard within defended areas adjoining the River Thames has also been carried out for planning purposes (refer Section 5.2). The spatial variation in fluvial (river) flood risk across the Borough has been delineated in the following manner:

#### Zone 3b (Functional Floodplain)

5. Areas subject to flooding in the 5% (20 year) design event have been delineated as Zone 3b Functional Floodplain. It is important to recognise that all areas within Zone 3b are areas that are subject to relatively frequent flooding, and may be subject to fast flowing and/or deep water. Very careful consideration must be given to future sustainability and safety issues within this area.

#### Zone 3a High Probability

6. Areas subject to flooding in the 1% (100 year) design event have been delineated as Zone 3a High Probability. Development within these areas may only be considered following application of the Sequential Test, and 'more vulnerable' development should be avoided wherever possible.

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<sup>1</sup> It is highlighted that steady population growth within the Borough in the proceeding 6 years will have increased the number of people residing within areas at risk of flooding

<sup>2</sup> Refer paragraphs 2.32 to 2.35 of the Living Draft of the Practice Guide Companion to PPS25 (February 2007)

<sup>3</sup> Refer paragraphs 2.36 to 2.42 of the Living Draft of the Practice Guide Companion to PPS25 (February 2007)

7. The SFRA has outlined specific development control recommendations that should be placed upon development within Zone 3a High Probability to minimise the damage to property, the risk to life in case of flooding, and the need for sustainable drainage techniques (SuDS). It is essential that the developer carries out a detailed Flood Risk Assessment to consider the site-based constraints that flooding may place upon the proposed development.

### **Zone 2 Medium Probability**

8. Areas subject to flooding in events exceeding the 1% (100 year) event, and up to (and including) the 0.1% (1000 year) event have been delineated as Zone 2 Medium Probability. 'Highly Vulnerable Development'<sup>4</sup>, for example emergency services, should be avoided in these areas. There are generally no other restrictions placed upon land use in these areas, however it is important to ensure that the developer takes account of possible climate change impacts to avoid a possible increase in the risk of flooding in future years (achieved through completion of a simple Flood Risk Assessment).

### **Zone 1 Low Probability**

9. There are no restrictions placed on land use within Zone 1 Low Probability (i.e. all remaining areas of the Borough) by PPS25. It is essential however that consideration is given to the potential risk of flooding from other sources (outlined in 'Localised Flooding Issues' below), ensuring that future development is not inadvertently placed at risk. It is also essential to ensure that future development does not exacerbate the current risk posed to existing homes and businesses.

### **Localised Flooding Issues**

10. Properties and infrastructure within the London Borough of Lewisham are also at risk of flooding from other sources. These include groundwater flooding, the surcharging of the underground sewer system, the blockage of culverts and gullies (which results in overland flow), and surface water flooding. Evidence of localised flooding of this nature has been captured through consultation with local authorities, Thames Water and the Environment Agency, and is provided in Figures 2 and 4<sup>5</sup>.
11. PPS25 does not address issues of this nature within its delineation of flood zones and what development is acceptable within them. Incidents of this nature can often be addressed through the design process, and therefore will not generally affect decision making with respect to the allocation (or otherwise) of sites within the Borough. The recent flooding throughout England highlights that this is certainly not always the case however, and uncontrolled flooding as a result of particularly heavy rains can create significant damage and disruption.
12. The PPS25 Practice Guide (A Living Draft, February 2007) advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. From a spatial planning perspective, with the exception of areas known to be susceptible to regular (and problematic) groundwater flooding, it is widely considered generally unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past.

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<sup>4</sup> Refer Table D2 (Appendix D) of PPS25

<sup>5</sup> It is highlighted that detailed mapping of areas within the River Ravensbourne catchment that are potentially at risk of surface water flooding is being established by the Environment Agency. Furthermore, in liaison with key catchment stakeholders, opportunities for flood risk mitigation (including development control responses) are being developed for the River Ravensbourne catchment. This is discussed further in Section 5.3 and Section 7.3.4. The SFRA should be reviewed in due course to incorporate this information as it becomes available.

13. It is essential however not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Specific development control recommendations have been provided accordingly (refer Section 7.4).
14. As a minimum, the implementation of sustainable drainage systems (SuDS) must be ensured and careful consideration to overland flow routes (and avoidance of their obstruction), as part of the site design, should be encouraged.

### **A Proactive Approach – Reduction in Flood Risk**

15. It is crucial to recognise that PPS25 considers not only the risk of flooding posed to new development, but that it also seeks to positively reduce the risk of flooding posed to existing properties within the Borough. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within Lewisham Borough.
16. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the Borough, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should be reflected through the inclusion of a positive statement within the detailed FRA that clearly and concisely summarised how this reduction in flood risk will be delivered.

### **The Way Forward**

17. Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out in accordance with PPS25, developed in close consultation with both the Council and the Environment Agency. The Borough has been broken down into zones of 'high', 'medium' and 'low' probability of flooding in accordance with PPS25, providing the basis for the application of the PPS25 Sequential Test.
18. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test. Specific planning recommendations have been provided for all urban centres within the Borough (refer Section 7.4).
19. Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, specific recommendations have been provided to assist the Council and the developer to meet the Exception Test. These should be applied as development control conditions for all future development (refer Section 7.4.4).
20. Council policy is essential to ensure that the recommended development control conditions can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the Borough with respect to flood risk management. It is recommended that supplementary planning guidance is developed to build upon emerging Council policy, in light of the suggested development control conditions presented by the Lewisham Borough SFRA.
  - Emergency planning is imperative to minimise the risk to life posed by flooding within the Borough. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Lewisham SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

## **A Living Document**

21. The Lewisham Borough SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Borough. A rolling programme of detailed flood risk mapping within the Thames region is underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk and may alter predicted flood extents within Lewisham Borough. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25, and future amendments to the PPS25 Practice Guide are anticipated.
22. Given that this is the case, a periodic review of the Lewisham SFRA is imperative. It is recommended that the Lewisham SFRA is reviewed on a regular basis, and a number of key questions to be addressed as part of the SFRA review process (i.e. triggering whether or not a comprehensive review is required) are provided in Section 8. It is reiterated that a review of the SFRA should be carried out in due course to integrate the findings and recommendations of the Ravensbourne Delivery Plan, currently under development by the Environment Agency.

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## Glossary

AEP	Annual Exceedance Probability e.g. 1% AEP is equivalent to 1% probability of flooding occurring in any one year (or, on average, once in every 100 years)
Spatial (Core) Strategy	The Development Plan Document within the Council's Local Development Framework, which sets the long-term vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.
DCLG	Department of Community and Local Government
Defra	Department of Environment, Food and Rural Affairs
Development	The carrying out of building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land.
Development Plan Document (DPD)	A spatial planning document within the Council's Local Development Framework, which set out policies for development and the use of land. Together with the Regional Spatial Strategy, they form the development plan for the area. They are subject to independent examination.
EA	Environment Agency
Flood Zone Map	Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency
Formal Flood Defence	A structure built and maintained specifically for flood defence purposes
Informal Flood Defence	A structure that provides a flood defence function, however has not been built and/or maintained for this purpose (e.g. boundary wall)
Local Development Framework (LDF)	Consists of a number of documents which together form the spatial strategy for development and the use of land
Zone 1 Low Probability	PPS25 Flood Zone, defined as areas outside of Zone 2 Medium Probability
Zone 2 Medium Probability	PPS25 Flood Zone, defined as areas at risk of flooding in events that are greater than the 1% AEP (1 in 100) for rivers or the 0.5% AEP (1 in 200) design event from the sea, and less than the 0.1% AEP (1 in 1000) design event
Zone 3a High Probability	PPS25 Flood Zone, defined as areas at risk of flooding in the 1% AEP (1 in 100) design event from rivers, or the 0.5% AEP (1 in 200) design event from the sea
Zone 3b Functional Floodplain	PPS25 Flood Zone, defined as areas at risk of flooding in the 5% AEP (1 in 20 chance) design event
Planning Policy Statement (PPS)	A series of statements issues by the Government, setting out policy guidance on different aspects of planning. They replace Planning Policy Guidance Notes

Planning Policy Guidance (PPG)	A series of notes issued by the Government, setting out policy guidance on different aspects of planning. They will be replaced by Planning Policy Statements.
PPS25	Planning Policy Statement 25: Development and Flood Risk Department of Community & Local Government, 2006
Previously Developed (Brownfield) Land	Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example, a house and its garden would be considered to be previously developed land.
Residual Risk	A measure of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the review process
SEA	Strategic Environmental Assessment
SUDS	Sustainable Drainage System
Supplementary Planning Document (SPD)	Provides supplementary guidance to policies and proposals contained within Development Plan Documents. They do not form part of the development plan, nor are they subject to independent examination.
Sustainability Appraisal (SA)	Appraisal of plans, strategies and proposals to test them against broad sustainability objectives.
Sustainable Development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987).

# 1 Introduction

## 1.1 Overview

23. The London Borough of Lewisham lies to the south east of the centre of London. The Borough fronts onto the River Thames for approximately 1km in the north and extends approximately 8km south from here. It falls within most of the catchment of the River Ravensbourne and its tributaries, which outfalls into the Thames at Deptford Creek. The Borough covers an area of approximately 35 square kilometres and has a population of 248,922 in 107,412 households (2001 Census<sup>6</sup>).
24. The National Flood Risk Assessment (NaFRA)<sup>7</sup> covering the whole of England and Wales is a method for flood risk assessment that uses a risk-based approach to factor in the location, type, condition and effects of flood defences. According to this assessment, properties in Lewisham fall in the categories shown in Table 1.1. All of the properties in the flood risk area adjacent to the Thames fall within the low risk category, while those in the River Ravensbourne catchment fall in the moderate or significant risk category.

**Table 1.1 National Flood Risk Assessment (NaFRA) statistics for the London Borough of Lewisham**

<b>Risk category</b>	<b>Number of properties at risk (residential &amp; non-residential)</b>
<b>Low</b> 0.5% (1 in 200) chance of flooding each year or less	17,047
<b>Moderate</b> 1.3% (1 in 75) chance or less but greater than 0.5% (1 in 200) chance of flooding in any year	991
<b>Significant</b> greater than 1.3% (1 in 75) chance of flooding in any year	3420
<b>Total number of properties at risk</b>	21,458

25. The River Thames has posed a risk of flooding to London for millennia, and as the city grew, the river became more and more constrained by urban development. The natural floodplain of the River Thames within London is now almost fully developed, and the northern proportion of the Borough of Lewisham (adjoining the River Thames) is heavily dependant upon manmade flood defences to protect against the risk of flooding. Substantial investment has been committed to the protection of London, both now and into the future, as set out by the TE2100 Strategy (Environment Agency).

<sup>6</sup> It is highlighted that steady population growth within the Borough in the proceeding 6 years will have increased the number of people residing within areas at risk of flooding

<sup>7</sup> Environment Agency Flood Risk Data Report (March 2007 - based on information from April 2006)

26. As highlighted above however, the River Ravensbourne and River Quaggy are also key features of the Borough, flowing in a northerly direction through the heart of the Borough, and representing a potential risk of flooding to property and infrastructure. Investment has been made in flood risk management along the River Ravensbourne, both by the Environment Agency and the Council. This has included the construction of raised flood defences within Lewisham, and the development of dedicated landscaped areas for flood storage as part of ongoing regeneration within the Borough.
27. The Environment Agency is currently reviewing their future strategy for flood risk management within the Ravensbourne catchment (in consultation with the Council) as an integral part of the River Thames Catchment Flood Management Plan (CFMP). As is the case in many areas of England, an ever increasing 'squeeze' is evident through competing needs for government funding for flood defence, and an increasing potential risk of flooding due to pressure for future development and climate change. **For this reason, a key focus of the strategy is the need to proactively deliver a reduction in flood risk through the planning process – in simple terms, guiding vulnerable development away from areas that are most at risk, and adopting sustainable design techniques.**
28. This philosophy is also clearly evident within other strategic studies being developed by the Environment Agency relating more widely to the River Thames<sup>8</sup>, in particular the TE2100 Strategy. The Council embrace these core principles of sustainability, and these have underpinned the development of the Lewisham Borough SFRA.
29. Jacobs was commissioned to develop the Lewisham Borough Strategic Flood Risk Assessment (SFRA) in May 2007. The London Borough of Lewisham is currently reviewing its planning framework, and this SFRA supplements the evidence base that informs this review process. The SFRA is a technical document that will be submitted to the Secretary of State with the submission Core Strategy and supporting Development Planning Document (DPD). This SFRA will be developed and refined over time and will feed into the Council's emerging 'preferred options' for site allocation.

## 1.2 Future Development in Lewisham Borough

30. Lewisham is generally an economically buoyant part of southern London. It has a short stretch of frontage to the River Thames and is also characterised by Deptford Creek, where the River Ravensbourne, having joined the River Quaggy just north of Lewisham, meets the Thames. The Borough is mainly built up although there are significant areas of open space throughout the borough. The main urban centres are Lewisham and Catford. New Cross and Deptford also have local shopping facilities. There are significant rail routes crossing the borough, as well as the A2 and A20 taking coastal traffic to the channel ports.
31. Like other boroughs of inner east London, Lewisham is keen to take advantage of any opportunities for regeneration that arise. A number of regeneration areas have been identified by the Council, and are being articulated through the LDF in the form of Area Action Plans, one for Lewisham the main commercial centre of the borough, the other for Catford to the south. There are also key plans for the regeneration of Deptford and New Cross. These offer the potential for increased employment, improved urban spaces and the revitalisation of local communities with new housing, including for key workers. In accordance with The London Plan

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<sup>8</sup> Refer Section 7.3

Housing Provision Targets, Waste and Minerals Alterations adopted in December 2006, Lewisham will be expected to provide an additional 975 homes each year over the period 2007/8 to 2016/17.

32. The Council is currently preparing a Local Development Framework (LDF) in accordance with the Planning and Compulsory Purchase Act 2004. The LDF will replace the existing Unitary Development Plan (UDP)<sup>9</sup> and provide the basis for land use and spatial planning in the Borough. The Core Strategy Preferred Options report was issued in March 2007, and Preferred Options reports for each Area Action Plan were published in April 2007. These reports specifically address the opportunities for the two centres, identifying key sites and setting out the aspirations for them in some detail.

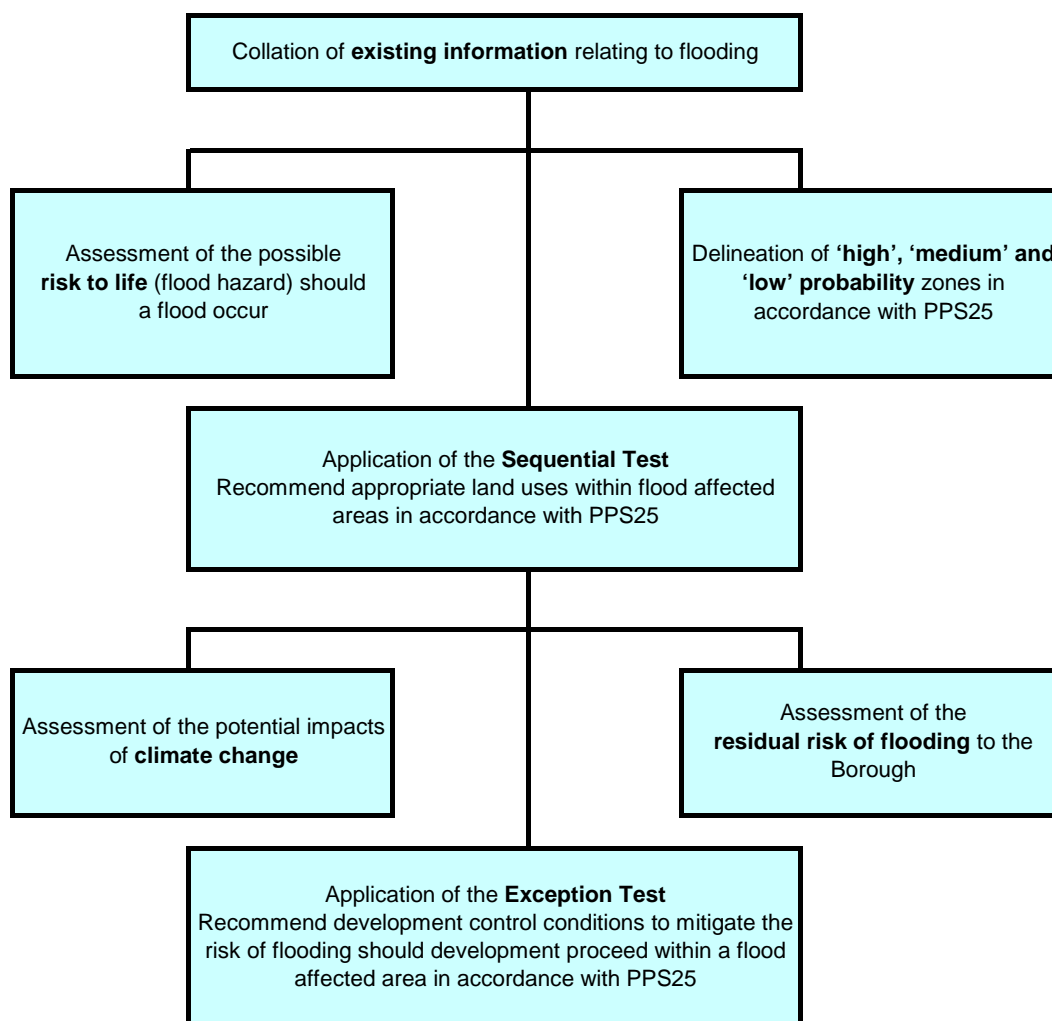
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<sup>9</sup> Adopted July 2004

## 2 SFRA Approach

33. The primary objective of this SFRA is to inform the revision of flooding policies, including the allocation of land for future development, within the emerging Local Development Framework (LDF). The SFRA has a broader purpose however, and in providing a robust depiction of flood risk across the Borough, it can:
  - Inform the development of Council policy that will underpin decision making within the Borough, particularly within areas that are affected by (and/or may adversely impact upon) flooding;
  - Assist the development control process by providing a more informed response to development proposals affected by flooding, influencing the design of future development within the Borough;
  - Help to identify and implement strategic solutions to flood risk, providing the basis for possible future flood attenuation works;
  - Support and inform the Council's emergency planning response to flooding.
34. The Government provides no specific methodology for the SFRA process. Therefore, to meet these broader objectives, the SFRA has been developed in a pragmatic manner in close consultation with both the Council and the Environment Agency.
35. A considerable amount of knowledge exists with respect to flood risk within the Borough, including information relating both to historical flooding, and the predicted extent of flooding under extreme weather conditions (i.e. as an outcome of detailed flood risk modelling carried out by the Environment Agency). The SFRA has built upon this existing knowledge, underpinning the delineation of the Borough into zones of 'high', 'medium' and 'low' probability of flooding, in accordance with PPS25. Within defended areas, these zones have then been subsequently sub-delineated on the basis of flood hazard (or potential risk to life), as described in Section 6.5. Collectively these flood zones will be used to provide a robust and transparent evidence base for the development of flooding related policy, and the allocation of sites for future housing and employment uses.
36. A summary of the adopted SFRA process is provided in the figure below, outlining the specific tasks undertaken.





37. The River Thames catchment encompasses a large number of Boroughs within the Greater London area, and future development within the region could severely influence the risk of flooding posed to neighbouring areas if not carefully managed. It is imperative that all local authorities clearly understand the core issues that flood risk raises within their respective Boroughs, and adapt their decision making accordingly. They must be aware of the impact that careless planning may have, not only locally, but upon adjoining Boroughs.
38. A number of authorities across Greater London are beginning to carry out similar strategic flood risk investigations. These will help provide the evidence base for the Core Strategies and Site Specific development allocations that will form part of the Local Development Frameworks that all local planning authorities must now produce. Whilst the delivery teams and programmes underpinning these studies vary from one district to the next, all are being developed in close liaison with the Environment Agency. Consistency in the adopted approach and decision making with respect to the effective management of flood risk throughout the sub region is imperative. Regular discussions with the Environment Agency have been carried out throughout the SFRA process to this end, seeking clarity and consistency where needed.

## 3 Policy Framework

### 3.1 Introduction

39. This section provides a brief overview of the strategy and policy context relevant to flood risk in the Borough.
40. The success of the SFRA is heavily dependent upon the Council's ability to implement the recommendations put forward for future sustainable flood risk management, both with respect to planning decisions and development control recommendations (refer Section 7.4). A framework of national and regional policy directive is in place, providing guidance and direction to local planning authorities. Ultimately however, it is the responsibility of the Council to establish robust policies that will ensure future sustainability with respect to flood risk.

### 3.2 National Policy

#### 3.2.1 Introduction

41. This section provides a brief overview of planning policy relating to Lewisham in terms of flood risk. The SFRA is a key point of reference to the Council in developing their flood risk policies, and this part of the document is designed to facilitate policy development.

#### 3.2.2 Planning Policy Statement 25: Development and Flood Risk<sup>10</sup>

42. Planning Policy Statement 25 (PPS25) was published in December 2006 and sets out the planning objectives for flood risk management. It states that all forms of flooding and their impacts are material planning considerations, which gives much weight to the issue of flooding. The aim of PPS25 is to ensure that flood risk is taken into account at all stages of the planning process in order to prevent inappropriate development in 'at risk' areas.
43. The key objectives for planning are appraising, managing and reducing flood risk. To *appraise* the risk it is stated that flood risk areas need to be identified, and that the level of risk needs to be identified. To facilitate this, PPS25 indicates that Regional Flood Risk Appraisals (RFRA) and Strategic Flood Risk Assessments should be prepared. The draft London RFRA is discussed below.
44. To *manage* the risk, Local Planning Authorities (LPAs) need to develop policies which "avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change". LPAs should also only permit development in flood risk areas if there are no reasonably available sites in areas of lower flood risk.
45. To *reduce* the risk, PPS25 indicates that land needed for current or future flood management should be safeguarded; new development should have an appropriate location, layout and design and incorporate sustainable drainage systems (SUDS); and new development should be seen as an opportunity to reduce the causes and impacts of flooding by measures such as provision of flood storage, use of SUDS, and re-creating the functional flood plain.
46. A partnership approach is stressed in PPS25 to ensure that LPAs work with partners such as the Environment Agency. The Environment Agency can provide both

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<sup>10</sup> Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk

information and advice relating to flood risk, and should always be consulted when preparing policy or making decisions which will have an impact on flood risk.

47. The future impacts of climate change are highlighted in PPS25, as climate change will lead to increased flood risk in many places in the years ahead. When developing planning policy, LPAs need to consider if it is necessary to encourage the relocation of existing development to locations at less of a risk from flooding in order to prevent future impacts of flooding.
48. PPS25 also gives specific advice for determining planning applications, which needs to be considered when developing policy. LPAs should ensure that flood risk assessments (FRAs) are submitted with planning applications where this is appropriate; they should apply the sequential approach (defined in the PPS) which ensures that lower risk areas are considered preferable to higher risk areas; priority should be given to the use of SUDS; new development should be designed to be resilient to flooding as appropriate; and they should ensure that residual risks can be safely managed..
49. The “Development and Flood Risk Practice Guide” to PPS25, published by the Department for Communities and Local Government in June 2008, uses good practice through case studies and examples to show how policies in PPS25 can be delivered, taking into account circumstances at the borough level.



### **3.2.3 Planning Policy Statement: Planning and Climate Change<sup>11</sup>**

50. The planning policy statement for climate change was published in December 2007. It supplements the existing PPS1: Delivering Sustainable Development. The document highlights the issue of climate change, and sets out ways planning should prepare for its effects, which includes managing flood risk. Little detail is given about flooding in this document as PPS25 already does this.



## **3.3 Regional Planning Policy**

### **3.3.1 The London Plan<sup>12</sup>**



51. The London Plan is the adopted regional spatial strategy relevant to the London Borough of Lewisham. This document includes a number of policies relevant to flood risk in the Lewisham area. The key policies relate to flood plains; flood defences; sustainable drainage; rising groundwater; and climate change.
52. Chapter 4C sets out the spatial strategy and policies for the Blue Ribbon Network, which includes the Thames, the canal network, the other tributaries, rivers and streams within London and London’s open water spaces such as docks, reservoirs and lakes.
53. Paragraph 4.38 of the London Plan identifies that the management of flood risk is critical to London’s future. Consequently the Plan seeks to ensure that all future development minimises the risk of flooding within the Capital.
54. Policy 4A.12 “Flooding” is particularly relevant stating that Boroughs in reviewing their Development Plans should identify areas at risk from flooding. Within these areas the assessment of development proposals should be carried out in line with PPS25. This SFRA document identifies the areas at risk from flooding within the London Borough of Lewisham following the principles set out in PPS25. The policy indicates that Boroughs should avoid permitting built development in functional flood plains. Functional Floodplain is defined as that area which falls within the 1 in 20 annual chance event flood envelope. It is further defined as:

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<sup>11</sup> Communities and Local Government (2007) Planning Policy Statement: Planning and Climate Change: Supplement to Planning Policy Statement 1

<sup>12</sup> Mayor of London (2008) The London Plan: Spatial Development Strategy for Greater London

- land where the flow of flood water is not prevented by flood defences or by permanent buildings or other solid barriers from inundation during times of flood;
  - land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas).
55. Policy 4A.13 “Flood Risk Management” highlights the need to set back permanent development from flood defences to allow for replacement or repair of the defences. This is an issue for Lewisham as there are a number of flood defences located in the borough, such as the Thames Tidal Defences. The London Borough of Lewisham will need to ensure that any new development near to the defences is set back from them, and that any new development does not undermine or breach the defences.
56. Policy 4A.14 “Sustainable Drainage” seeks to ensure that surface water run-off is managed close to its source and recommends that sustainable urban drainage systems (SuDS) are promoted for new developments unless there are practical reasons for not doing so. It is important that local planning policy provides clear guidance relating to sustainable drainage within emerging development areas in Lewisham.
57. Policy 4A.15 “Rising Ground Water” highlights the importance of abstracting groundwater in areas where the rising ground water is a problem in considering planning applications for major developments. London area has a history of rising ground water as the major industrial abstractions have stopped.
58. The Regions housing targets over the plan period are given in policy 3A.1 “Increasing London’s Supply of Housing” and subsequent table 3A.1. These state that the Mayor will seek a minimum provision of 30,500 additional homes per year from all sources in London. Within the Borough of Lewisham an annual monitoring target of 975 additional housing is sought per year.
59. The policies mentioned above will need to be considered when the borough is considering how to allocate land, in particular, in order to meet development pressures such as the need for additional housing.

### 3.3.2 Draft Regional Flood Risk Appraisal<sup>13</sup>

60. One of the key elements of PPS25 is to introduce a hierarchy of Flood Risk Appraisal and the requirement for Regional Planning bodies to produce a Regional Flood Risk Assessment (RFRA) to accompany Regional Spatial Strategies. The recently published draft of the RFRA for Greater London has been undertaken with the assistance of the Environment Agency and is currently going through an informal consultation stage with key agencies before being finalised (expected 2008).
61. The RFRA is a strategic overview of flood risk across London. It does not represent a detailed analysis of flood risk in relation to any particular areas or sites. It contains a series of recommendations which are either region wide or applicable to boroughs in undertaking their SFRA to accompany emerging Local Development Documents. The RFRA will remain a live document with regular updates to reflect the changing position in relation to both climate change and development pressure and policy responses. The RFRA should be useful to spatial planners, developers, infrastructure and utility operators and emergency planners. It is a specific aim of the RFRA to bring spatial planners and emergency planners into closer communication.
62. The Draft Regional Flood Risk Appraisal (RFRA) provides the following recommendations of specific relevance to the London Borough of Lewisham:
- Recommendation No. 2 - All Thames-side planning authorities should put in place policies to promote the setting back of development from the river edge to enable sustainable and cost effective upgrade of river walls/embankments, in line with London Plan Policy 4C.6 (FALP policy 4A.5vi);

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<sup>13</sup> Regional Flood Risk Appraisal - draft for informal consultation, June 2007

- Recommendation No. 6 - Developments all across London should implement the Drainage Hierarchy set out in Policy 4A.5vii of the FALP (refer Section 7.6);
  - Recommendation No. 7 - Regeneration and redevelopment of London's fluvial river corridors offer a crucial opportunity to reduce flood risk. Strategic Flood Risk Assessments and policies should focus on making the most of this opportunity through appropriate location, layout and design of development as set out in PPS25 and the Thames Catchment Flood Management Plan (CFMP)<sup>14</sup>. In particular opportunities should be sought to:
    - Set back of development from the river edge to enable sustainable and cost effective flood risk management options (FALP Policy 4A.5vi).
    - Ensure that the buildings with residual flood risk are designed to be flood compatible or flood resilient (FALP Policy 4A.5vi)
    - Use open spaces within developments which have a residual flood risk to act as flood storage areas
  - Recommendation No. 10 – Organisations responsible for development with large roof areas should investigate providing additional surface water runoff storage;
  - Further strategic recommendations are provided for key development types throughout the region including (for example) schools, hospitals and emergency services. These recommendations focus heavily upon ensuring that the risk of flooding is minimised through the design process.
63. The RFRA deliberately crosses the boundary between land use planning and emergency planning, which has been done to stimulate greater links between these disciplines. The London Resilience Team has recently published its "London Flood Response Strategy Plan" (March 2007) and its revised "Strategic Emergency Plan" (January 2008) . These plans seek to co-ordinate emergency services and emergency planners across London in the event of a major flood. It will be important to foster links between the RFRA and the LFRSP and SEP).

### 3.3.3 Supplementary Planning Guidance – Sustainable Design & Construction<sup>15</sup>

- Clause 2.4.4 of the SPG (Water Pollution and Flooding) sets out a series of standards that are to be sought through local planning policy. These form the framework within which the development control recommendations established within the Lewisham SFRA have been developed (in consultation with the Council and the Environment Agency). The 'Essential Standards' sought through the SPG are:
  - use of SUDS measures wherever practical; and
  - achieve a 50% attenuation of the undeveloped site's surface water runoff at peak times
  - Furthermore, the 'Mayor's Preferred Standard' is:
    - achieve a 100% attenuation of the undeveloped site's surface water runoff at peak times
  - Specific guidance is provided to assist Boroughs in the achievement of these desired standards, and these are outlined as following:
    - Incorporating Sustainable Drainage Systems (SuDS) - as an alternative to traditional approaches to managing runoff from buildings and hardstanding. SuDS reduce the total amount, flow and rate of surface water that runs directly to rivers through stormwater systems which is a contributory factor in flooding incidents and affects the biological quality of waterways. It may not be possible to achieve the preferred standard in situations where a proposed development is of high density,

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<sup>14</sup> In particular, the River Ravensbourne policy unit (refer Section 7.1)

<sup>15</sup> Mayor of London (May 2006)

particularly in central London or town centres or where there are high levels of contamination in ground conditions.

➤ Identifying potential sources of flooding and assessing their possible impacts both now and in the future - any development proposed needs to consider flood risk from a variety of possible sources, such as watercourses, groundwater, foul and surface water sewer and overland flow. The Environment Agency publishes flood maps showing tidal and non tidal river flood plains. Other sources will need to be considered on a more localised basis. All development must conform to the sequential test set out in PPG25 (now further developed in consultation on PPS25) and supported by the London Plan (Policy 4C.6). This makes it clear that development in functional floodplains or inappropriately defended floodplains should be wholly exceptional. Development should incorporate safe access routes above the flood levels likely during the design life of the development.

➤ Adopt principles of flood resistant design - The Environment Agency is opposed to unsustainable land uses within areas of flood risk. It is working to influence development patterns to minimize risk, primarily by developing land outside flood plains first, followed by land at lowest risk in defended areas. Some forms of development need to be beside rivers, for example, boat clubs. These should be designed so that they can be flooded without causing any undue damage. In other areas development can be designed to be flood resistant. For example putting living accommodation on the first floor or building on stilts. Roof drainage can also be designed to cope with the higher levels of rainfall and increased occurrence of storms expected from climate change.

### 3.3.4 Mayor's Draft Water Strategy: Water Matters (March 2007)

64. *The draft Water Strategy states: "Most people in London expect to turn on the tap and get water without having to think about where it comes from. Equally, people want to be able to pull out the plug and let water run away without having to worry about what happens to it afterwards. However, changes are going on around us that mean that Londoners will have to pay more attention to where water comes from and goes to. London is a dynamic, growing city and, like other world cities, is facing the effects of a changing climate. Together these pressures will aggravate the stress on existing systems by placing:*

- *A greater demand for water from the mains network, and therefore from the environment;*
- *An increased flow to, and discharges from, the sewage treatment works*
- *A greater risk of surface flooding as rainwater runs off new houses, driveways and roads;*
- *An increase in storm and tidal surge;*
- *All in all, this means we will need increasingly to plan and co-ordinate all aspects of water management than in the past."*

65. To address these issues, the Draft Water Strategy sets out specific proposals for future management of water and wastewater within Greater London. These are outlined below.

#### "Chapter 7 – Disposal of Wastewater in London (Proposal 11)

*As part of the next periodic review, the sewerage undertaker with the support of the London Boroughs should seek to establish a firm programme to remove those properties and areas in London from the risk register that are at risk of flooding from overloaded sewers."*

#### "Chapter 8 – Flood Risk in London (Hierarchy 5)

*The Mayor proposes the following hierarchy for managing floods in London:*

- *Avoid types of development that are vulnerable to flooding in flood risk areas*
- *Where this is avoidable, reduce the vulnerability through design and construction techniques by providing space for rivers and tidal processes to occur. Also, by*

- increasing the resilience of buildings to floods through design and construction techniques such as raising electrical services*
- *Alleviate the risk of flooding through flood defences.”*

“Chapter 8 – Flood Risk in London (Proposal 13)

*Developers should determine, in consultation with the Environment Agency, the sewerage undertaker, Transport for London and the relevant London Borough, whether their proposed development site is at risk from flooding. Developers seeking to develop a site at risk from flooding should undertake an appropriate flood risk assessment. All flood risk management proposals should avoid increasing flood risk to neighbouring areas.”*

### 3.4 Local Planning Policy

#### 3.4.1 Adopted London Borough of Lewisham Unitary Development Plan<sup>16</sup>

66. The Lewisham Unitary Development Plan was adopted in July 2004. In relation to flooding it states that development in the floodplain may increase the risk of flooding elsewhere, by reducing the storage capacity of the floodplain and on impeding on the flow of flood water. It goes on to state that where development is permitted on the floodplain or other areas liable to flooding then suitable mitigation measures should be in place. Notwithstanding this policy ENV.PRO 14 Controlling Development in the Flood Plain states that:
- “Within areas liable to flood development will not normally be permitted for new residential or non-residential development including extensions, unless it can be demonstrated to the satisfaction of the Borough that the proposal would not, itself or cumulatively with other development:
    - (a) impede the flow of water, or;
    - (b) reduce the capacity of the flood plain to store flood water, or;
    - (c) increase the number of people or properties at risk from flooding.”
67. In addition to the above Policy ENV.PRO 15 Sustainable Surface Water Drainage in New Development states that surface water should be disposed of as close to source as possible, or be attenuated before discharge to a watercourse or surface water sewer. This aims to reduce the effects of surface water runoff on increasing flood risk.
68. Whilst the above policies seek to deal with future development and flood control, protecting existing flood control measures is also considered with parts of the Borough already protected from flooding by tidal and fluvial defences. The plan seeks to protect these vital defences stating at Policy ENV.PRO 16 that development that would adversely affect the integrity of London’s tidal or fluvial defences will not be permitted.

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<sup>16</sup> London Borough of Lewisham Unitary Development Plan (July 2004)

### 3.4.2 London Borough of Lewisham Local Development Framework (LDF)

69. Lewisham Council is currently preparing its Core Strategy. The Core Strategy will be the most important document for inclusion in the Local Development Framework. It contains the vision and objectives for the borough and sets out the overall strategy for managing change and development. In line with the revised Planning Policy Statement 12 (PPS 12), 2008, the emerging Core Strategy will in time be submitted to the Secretary of State for consideration and approval by an independent inspector before being formally adopted by the Council.
70. The approved and adopted Core Strategy will set out policy on water management and flood risk to :-
- Minimise and control the risk of flooding; and,
  - Conserve water resources by encouraging the use of water saving devices, water harvesting systems and Sustainable Urban Drainage Systems (SUDS).
  - Apply the sequential test to development in zone 3 flood risk areas.
  - Only permit minor household extensions in flood hazard areas.
  - Adopt a risk based approach for development in flood risk areas.
  - Balance the management of social and economic needs and flood risk.
  - Require flood protection and mitigation measures in flood zone 3 via s106 agreements (planning obligations).
  - Development proposals accompanied by mitigating measures to be subject to a sustainability appraisal.
  - Require the use of sustainable urban drainage systems (SUDS).
  - Protect and improve river water quality.
  - Protect and conserve water supplies with sustainable use of water resources.
  - Ensure adequate water and sewerage infrastructure capacity.
71. The emerging LDF policy should be in keeping with the key underlying principles set out in PPS25. It is recommended that Development Control Policies DPD, or a Supplementary Planning Document should consider the specific recommendations for future development within flood affected areas as set out in this document. These recommendations have been identified and agreed in close consultation with the Environment Agency and the Council. They represent the minimum conditions that will be expected by the Environment Agency should development be permitted to proceed.



## 4 Data Collection

### 4.1 Overview

72. A considerable amount of knowledge has been collated to inform the analysis (and delineation) of flood risk throughout the Borough, including (but not limited to):

- Historical river flooding information;
- Information relating to localised flooding issues (surface water, groundwater and/or sewer related), collated in consultation with the Council and the Environment Agency;
- Detailed flood modelling for the River Ravensbourne;
- Locality and condition of raised flood defences;
- Environment Agency Flood Zone Maps (December 2007);
- Topography (LiDAR).

73. This data has been sourced from key stakeholders, as highlighted below. The interpretation of this data to inform the delineation of zones of 'high', 'medium' and 'low' probability of flooding in accordance with PPS25 is explained in Section 5, and the findings of this interpretation is outlined in Section 6. The formulation of planning and development control recommendations is provided in Section 7.

### 4.2 Consultation

74. Consultation has formed a key part of the data collation phase for the Lewisham Borough SFRA. The following key stakeholders have been comprehensively consulted to inform the current investigation:

#### **London Borough of Lewisham**

*Planning:* Consulted to identify areas under pressure from development and/or regeneration

*Highways:* Consulted to identify areas potentially at risk from surface water flooding

*Emergency Planning:* Consulted to discuss the Borough's existing emergency response to flooding

#### **Environment Agency**

The Environment Agency has been consulted to source specific flood risk information to inform the development of the SFRA. In addition, the Environment Agency is a statutory consultee under PPS25 and therefore must be satisfied with the findings and recommendations for sustainable flood risk management into the future. For this reason, the Environment Agency has been consulted during the development of the SFRA to discuss potential flood risk mitigation measures and planning recommendations.

#### **Thames Water**

Thames Water is responsible for the management of urban drainage (surface water) and sewerage within the Borough. Thames Water was consulted to discuss the risk of localised flooding associated with the existing drainage/sewer system.

#### **London Fire Brigade**

Anecdotal information relating to observed flooding within the Borough was sought from the London Fire Brigade, however no information could be made available for the study.

### 4.3 Environment Agency Flood Zone Maps

75. The Environment Agency's Flood Map shows the natural floodplain, ignoring the presence of defences, and therefore areas potentially at risk of flooding from rivers or the sea. The Flood Map shows the area that is susceptible to a 1 in 100 (1% annual exceedance probability (AEP)) chance of flooding from rivers, and a 1 in 200 (0.5% AEP) chance of tidal flooding, in any one year. It also indicates the area that has a 1 in 1000 (0.1% AEP) chance of flooding from rivers and/or the sea in any given year. This is also known as the Extreme Flood Outline.
76. The Flood Map outlines have been produced from a combination of a national generalised computer model, more detailed local modelling (if available), and some historic flood event outlines. Within the tidal reaches of the River Thames (including the London Borough of Lewisham) the Flood Map has been developed on the basis of detailed two dimensional modelling. The Environment Agency's Flood Map provides a consistent picture of flood risk for England and Wales.
77. The Environment Agency's knowledge of the floodplain is continuously being improved by a variety of studies, detailed models, data from river flow and level monitoring stations, and actual flooding information. They have an ongoing programme of improvement, and updates are made on a quarterly basis where more accurate information is available.

### 4.4 Historical Flooding

78. Discussions have been held with the Council to identify those areas within the Borough that are known to have been exposed to flooding in recent years, and these have been highlighted in the adjoining flood risk maps (and are summarised in Section 6 below).
79. It is important to recognise that the incidents listed are events in which areas have been affected not only by flooding from the River Ravensbourne and the River Thames, but also from surcharging of the underground sewer system, blockage of culverts and gullies, and/or surface water runoff or groundwater.
80. It is important to recognise that often the *cause* of observed flooding is difficult to ascertain, particularly after the floodwaters have passed. Finally, whilst prescriptive information relating to the precise location and depth of flooding is not always available, anecdotal information highlights the importance of careful and informed decision making when locating future development within a Borough..

### 4.5 Detailed Hydraulic Modelling

81. A detailed representation of flooding is being carried out on behalf the Environment Agency along the River Ravensbourne and its tributaries<sup>17</sup>. This has been undertaken following re-alignments, changes in channel geometry, defence works and improvements in modelling techniques, in order to update the flood maps generated under Section 105 (2) of the Water Resources Act. The model will produce flood extents for a range of flood event magnitudes, and include the presence and effect of formal defences which exist in the catchment. These are identified in Section 4.6 below. However the results of this modelling have not yet been incorporated into the current flood zone mapping released by the Environment Agency and used in this report.
82. It should be noted that the detailed hydraulic models developed on behalf of the Environment Agency assume 'typical' conditions within the respective river systems

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<sup>17</sup> Detailed flood risk mapping for the River Ravensbourne, Halcrow (2008)

that are being analysed. The predicted water levels may change if the operating regimes of the rivers involved are altered (e.g. engineering works which may be implemented in the future), if culverts become blocked, or if the condition of the river channel is allowed to deteriorate.

83. The Environment Agency is also undertaking the Thames Estuary 2100 (TE2100) project, investigating the risks of flooding at a more detailed level to inform the flood risk management strategy for the area up to the year 2100.

## 4.6 Flood Defences

84. Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that was built specifically for the purpose of flood defence, and is maintained by its respective owner, which could be the Environment Agency, Local Authority, or an individual. An 'informal' flood defence is a structure that has not been specifically built to retain floodwater, and is not maintained for this specific purpose, but may afford some protection against flooding. These can include boundary walls, industrial buildings, railway embankments and road embankments situated immediately adjacent to rivers. Within the London Borough of Lewisham, protection is also provided against flooding by the River Thames Barrier.
85. Formal raised flood defences within the Borough have been identified in consultation with the Environment Agency, providing protection against tidal and fluvial flooding from the River Thames. These are indicated in Figure 3. The height of the River Thames defence walls (along the northern boundary of the Borough) is set by an Act of Parliament<sup>18</sup>. These were raised in the mid 1970s as interim protection measures in conjunction with the construction of the Thames Barrier. With completion of the barrier, the walls at their original heights provide a standard of defence against a combined fluvial and tidal event of 0.1% (1 in 1000) chance of occurring in any year. The condition of these defences is also shown in Figure 3 and falls within the range Grade 2 or 3 (good to moderate).
- Within the River Ravensbourne catchment, as part of a major flood alleviation scheme undertaken between 1964 and 1974, many of the channels in the catchment were culverted or converted to concrete channels, which provided a standard of protection against flood events with a return period of up to 1 in 30 years. There have been a number of flood mitigation schemes carried out within the River Ravensbourne and River Quaggy catchment since the works carried out in the 1970s, and these are summarised in the table below.

Reach/Location	Details
Brookmill Park (re-alignment)	A 450m diversion as part of the Docklands Light Rail (DLR) extension in 1998 on the Ravensbourne at Deptford.
Bell Green Gas Works (re-alignment)	A 650m diversion of original channel on the River Pool as part of the gas works redevelopment in 1995, Standard of Protection (SoP) increased to 50 years.
Former Glaxo Wellcome Site, Langley Park (re-alignment)	Diversion and opening up of culverts on the East Beck, carried out during a large housing development at this site.

<sup>18</sup> Thames River Prevention of Floods Acts (1879 – 1962)

Reach/Location	Details
River Quaggy FAS from Sutcliffe Park to confluence with Ravensbourne (storage areas, raised defences and channel restoration)	The Quaggy FAS was completed in December 2006. The project provides two flood storage areas, raised defences and some channel restoration through Greenwich and Lewisham. The standard of protection is 100 years for the storage area at Sutcliffe Park however it is 70 years for the rest of the scheme.
Chinbrook Meadows (channel re-alignment and flood storage)	River restoration works carried out in 2002 for the creation of a natural meandering channel and flood storage, giving a standard of protection of 100 years.
Sundermead Estate, Elmira Street, Lewisham (channel re-profiling)	Channel re-profiling, bridge replacement and bridge raising have taken place as part of a housing development.
Lewisham, the new Town Centre Open Space (channel re-profiling)	Channel re-profiling has taken place as part of an urban re-generation programme by the Lewisham Council.
Sundridge Park Golf Course on Kyd Brook/Quaggy (channel re-alignment)	Channel re-alignment 1995-1996. (outside the Borough)
Chislehurst Railway Culvert (culvert renovation)	A culvert beneath the Chislehurst railway embankment, downstream of Woodlands Road, has been renovated (reduced in size to a 1.2m diameter pipe) as part of the Channel Tunnel Rail Link project. (outside the Borough)

86. No particular informal *raised* flood defences providing protection from flooding have been identified in Lewisham as part of the SFRA process. It is important to recognise however that local roads and/or rail lines that have been constructed on raised embankments may alter overland flow routes, and as such may have a localised effect upon the risk of flooding. This should be carefully reviewed in a local context as part of the detailed site based Flood Risk Assessment.

## 4.7 Topography & Geology

87. Detailed topographic information has been provided by the Environment Agency (2007) for a large proportion of the Borough in the form of LiDAR. LiDAR enables a detailed Digital Elevation Model (DEM) to be developed that, in simple terms, provides a three dimensional representation of the Borough.
88. Geological information has been retrieved from the British Geological Society (BGS), providing an overview of soils and substrate.

## 5 Data Interpretation

The data captured from key sources to inform the development of the Lewisham SFRA is outlined in Section 4 above. This section provides an overview of how this data was interpreted to meet the requirements of PPS25. The findings of these analyses are presented in Section 6 below.

### 5.1 Delineation of the PPS25 Flood Zones (Fluvial & Tidal Flooding)

89. To inform the planning process, it is necessary to review flood risk across the Borough, categorising the area in terms of the likelihood (or probability) that flooding will occur.
90. The definitions of these flood zones are summarised below.

#### Zone 3b The Functional Floodplain

Areas of the region susceptible to flooding within which “*water has to flow or be stored in times of flood*” (PPS25).

#### Zone 3a High Probability

Land assessed as having a 1 in 100 or greater annual probability of flooding in any year (i.e. 1% AEP) from rivers or a 1 in 200 or greater annual probability of flooding in any year (i.e. 0.5% AEP) from the sea.

#### Zone 2 Medium Probability

Land assessed as having between a 1 in 100 (i.e. 1% AEP) and 1 in 1000 (i.e. 0.1% AEP) annual probability of river flooding in any year, or between a 1 in 200 (i.e. 0.5% AEP) and 1 in 1000 (i.e. 0.1% AEP) annual probability of flooding from the sea in any year.

#### Zone 1 Low Probability

Land assessed as having a less than 1 in 1000 annual probability of river flooding in any year (i.e. 0.1% AEP).

#### 5.1.1 Delineation of Zone 3b Functional Floodplain

91. Zone 3b Functional Floodplain is defined as those areas in which “*water has to flow or be stored in times of flood*”. The northern areas of the London Borough of Lewisham are defended against flooding from the River Thames, and therefore Zone 3b Functional Floodplain in these areas is restricted solely to areas of open water, including the River Thames. Throughout the remainder of the Borough, areas of natural floodplain adjoining the River Ravensbourne and the River Quaggy (i.e. that have a 5% (20 year) chance of flooding in any year) also fall within Zone 3b Functional Floodplain.
92. The detailed modelling outputs developed by the Environment Agency, where available (refer Section 4.5), have been adopted for the delineation of Zone 3b Functional Floodplain within the Borough of Lewisham.

#### *Existing Development within Zone 3b Functional Floodplain*

93. The PPS25 Practice Companion Guide highlights the importance of considering existing land use when delineating areas that are to be treated as ‘functional floodplain’ for planning purposes. Discussions with the Environment Agency have confirmed that, due to the obstructions to overland flow paths posed by existing development within flood affected areas, existing buildings that are impermeable to flooding should not be considered as falling within the functional floodplain. Notwithstanding this however, the land surrounding existing buildings within this zone is indeed Zone 3b Functional Floodplain, and planning decisions should be taken accordingly.

94. It is important to recognise that these areas are subject to relatively frequent flooding. There are clear safety, sustainability and insurance implications associated with future development within these areas, and informed planning decisions must be taken with care.

### 5.1.2 Delineation of Zone 3a High Probability

95. Zone 3a High Probability is defined as those areas of the Borough that are situated within the 1% AEP (100 year) fluvial or 0.5% AEP (200 year) tidal (whichever is greater) flood extent. For planning purposes, the Environment Agency has issued a series of Flood Zone Maps and the outlines dated September 2007, and these have been adopted to define Zone 3a High Probability within the London Borough of Lewisham SFRA.
96. It is highlighted that, whilst detailed modelling data is available for the River Ravensbourne catchment (refer Section 4.5), this modelling has assumed that the Ravensbourne defences are in place and functioning effectively. This is not appropriate when making planning decisions - it is essential that due consideration is taken of the residual risk posed by defence failure and/or lack of investment in future years. Consequently, for SFRA purposes, reliance has been placed upon the EA flood zones for the delineation of Zone 3a High Probability within the Borough of Lewisham in this instance.
97. Within the northern proportion of the Borough that is defended against flooding from the River Thames, Zone 3a High Probability has been sub-delineated into zones of 'hazard' (reviewing the potential risk to life), considering the impact of a failure of the River Thames defences. This is discussed further in Section 6.5 below.

### 5.1.3 Delineation of Zone 2 Medium Probability

98. Zone 2 Medium Probability is defined as those areas of the Borough have between a 1 in 100 (i.e. 1% AEP) and 1 in 1000 (i.e. 0.1% AEP) annual probability of river flooding in any year, or between a 1 in 200 (i.e. 0.5% AEP) and 1 in 1000 (i.e. 0.1% AEP) annual probability of flooding from the sea in any year. Zone 2 Medium Probability is defined on the basis of the Environment Agency Flood Zone Map.

### 5.1.4 Delineation of Zone 1 Low Probability

99. Zone 1 Low Probability is defined as those areas of the Borough that are situated above (or outside of) the 0.1% AEP (1000 year) flood extent. For SFRA purposes, this incorporates all land that is outside of the shaded Zone 2 and Zone 3 flood risk areas (as defined above).

## 5.2 Assessment of Risk (Flood Hazard)

100. The risk to life, associated with asset failure, within the London Borough of Lewisham has been assessed to inform the allocation of land within the Borough for future development. The analysis has considered both the risks associated with flood defence failure, and the possibility of failure of water storage facilities, as described in Section 6.5 below.
101. It is important to recognised that the assessment of flood risk has thus far considered the *likelihood* of flooding within the Borough, defined by the PPS25 flood zones. Of equal importance however is the *impact (or consequence)* that will occur within the Borough should a flood occur. For example, will the flooding result simply in shallow ponding for a short period of time, causing a temporary disruption to traffic? Or will deep fast flowing floodwaters inundate areas of the Borough without warning, posing an immediate and very real risk to life?

102. Substantial research has been carried out internationally into the risk posed to pedestrians during flash flooding. This research has concluded that the likelihood of a person being knocked over by floodwaters is related directly to the depth of flow, and the speed with which the water is flowing. This is referred to as 'Flood Hazard'.
103. For example, if a flood flow is relatively deep but is low energy (i.e. slow moving), then an average adult will be able to remain standing. Similarly, if the flow of water is moving rapidly but is very shallow, then once again an average adult should not be put off balance. If however the flow is both relatively deep and fast flowing, then a person will be washed off their feet, placing them at considerable risk. The risk to health and safety as a result of submerged hazards during flooding conditions (given the often murky nature of floodwaters) is also a consideration.

### 5.3 Local Drainage Issues

104. The risk of flooding from other (non river related) sources is an important consideration. The recent flooding that affected England, and particularly the South East, in August 2007 highlighted the potential risk that groundwater, surface water runoff and sewer flooding can have upon an area. Newbury (West Berkshire), Sheffield and Hull all suffered severe flooding from other sources.
105. Within Lewisham, information has been provided by the Council relating to anecdotal observations of localised flood risk problems that have occurred within the Borough. These are generally as a result of blocked culverts and gullies, surface water runoff, and failures of the underground sewer system during particularly intense rainfall. Some very general information has also been provided by Thames Water, providing a simple overview (per post code area) of the number of properties that have been affected by sewer flooding over the past decade.
106. Of course this information only relates to localised problems *once they have occurred*. PPS25 strongly advocates the prediction (where possible) of potential flood risk, seeking an avoidance strategy that guides development away from these areas wherever possible. Detailed modelling of surface water risks within the Ravensbourne catchment (encompassing the boroughs of Lewisham, Bromley and Greenwich) is underway by the Environment Agency at the time of writing<sup>19</sup>. In simple terms, the modelling considers the volume of water that will fall directly upon the catchment as a result of an intense rain event. An approximation is made of the capacity of the underground drainage system, and all excess runoff is routed across a two dimensional depiction of the catchment surface. This provides an indication of areas that may be at risk of deep flash flooding following a local storm.
107. It is understood that the emerging surface water flood risk maps will be available in late 2008. Until this time, the topography and geology of the Borough provides an interim means of identifying those areas within which surface water runoff is likely to cause the most disruption, and potentially damage to property. Areas in which the soils are highly impermeable (reducing the capacity of infiltration into the ground during periods of wet weather) and localised 'sags' in the topography (where ponding is likely to occur) can be considered locations within which the potential risk of localised flooding should be taken into account as part of the design process. The local geology also provides an indication of the likely presence (or otherwise) of a susceptibility to groundwater flooding. For example, areas of highly permeable gravel geology situated near a river may be at risk of groundwater flooding as the local water table rises following a rainfall event.
108. More generally however, development can fundamentally alter drainage patterns, obstructing overland flow routes, and altering the volume and speed of runoff. The SFRA has therefore captured all readily available information relating to localised flooding in an effort to inform future detailed FRAs. It is essential to highlight however that this should not be considered a comprehensive representation of all localised flood

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<sup>19</sup> Refer Ravensbourne Delivery Plan, discussed in further detail in Section 7.3.4

risks as indeed not all observed incidents may have been reported (and the blockage of culverts and gullies can happen anywhere).

## 5.4 Potential Impacts of Climate Change upon Flood Risk

109. A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime. PPS25 (Appendix B) states that a 10% increase in the 1% AEP (100 year) river flow can be expected within the next 20 years, increasing to 20% within the next 50 to 100 years. These impacts should be considered when reviewing the potential risk of flooding in future years within the River Ravensbourne catchment. In tidally affected areas within the east of England, including London, an increasing rate of change in predicted sea levels is to be assumed with time as summarised in the table below.

### Recommended Contingency Allowances for Net Sea Level Rise in London<sup>20</sup> (relative to 1990 base sea level)

1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
4.0mm/yr	8.5mm/yr	12.0mm/yr	15.0mm/yr

110. Within the northern proportion of the London Borough of Lewisham, at risk of flooding from the River Thames, the potential impact that climate change may have upon peak design river levels within the Thames is complicated to a large degree by the operation of the Thames Tidal Defences (TTD). As part of the TE2100 Strategy, a detailed review of the TTD design and operation into future years is underway by the Environment Agency. Currently the impacts of climate change can be mitigated by making space for water, and reducing reliance upon the barrier.
111. Clearly future investment in the TTD over the coming century cannot be assured today however, and therefore it is essential that planning policy takes a proactive stance when considering the potential impact of climate change. For this reason, developers working within this area should consult with the EA as part of the design process to seek advice on the appropriate climate change related design level to use for design purposes.
112. It is essential that developers consider the possible change in flood risk over *the lifetime of the development* as a result of climate change. The likely increase in flow and/or tide level over the lifetime of the development should be assessed proportionally to government guidance as outlined above. For design purposes, the Environment Agency recommend that the 'lifetime of development' is adopted as 60 years and 100 years for commercial and residential development respectively.
113. It is important to remember however that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river and/or tidal flooding, but it will also potentially increase the frequency and intensity of localised storms over the Borough. This may exacerbate localised drainage problems, and it is essential therefore that the detailed FRA considers the potential impacts of climate change upon localised flood risks, as well as the risks of river related flooding. PPS25 Appendix B (Table B2) provides guidance as to the anticipated increase in rainfall

<sup>20</sup> PPS25 (Appendix B, Table B1)



intensity that should be considered for design purposes. This is replicated in the table below.

**Recommended national precautionary sensitivity ranges for peak rainfall intensities,<sup>21</sup>**

1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
+5%	+10%	+20%	+30%

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<sup>21</sup> PPS25 (Appendix B, Table B2)

## 6 Flood Risk in the London Borough of Lewisham

### 6.1 Overview

#### *River Thames*

114. The northern proportion of the London Borough of Lewisham is situated immediately adjacent to the River Thames. Whilst the Thames poses a potential risk of flooding to properties within the this area of river frontage, property is currently protected from flooding by the River Thames Tidal Defences (TTD) up to the 1 in 1000 year event.
115. This degree of protection is effective provided that the River Thames Barrier is operated to protect against storm surges from the North Sea and that there is a sufficient storage pool behind the barrier to accommodate the River Thames when it is shut during extreme fluvial events at high tides. The TTD are currently being reviewed to protect against climate change beyond 2030.

#### *River Ravensbourne & River Quaggy*

116. The River Ravensbourne and the River Quaggy are key features of the Borough of Lewisham, and properties within the vicinity of the river corridors are subject to a potential risk of fluvial (river) flooding. Investment has been placed into flood defence to reduce the risk of flooding, particularly within Lewisham town centre, however fluvial flooding remains a threat to property (and potentially life) within the Borough. Both the Council and the Environment Agency are encouraging a more sustainable planning-led approach to further reducing flood risk in the future, and this is discussed further in Section 7 below.

#### *Localised Flood Risk*

117. A potential risk of flooding from other (non river related) sources exists throughout the Borough, including possible sewer surcharging, and surface water flooding as a result heavy rainfall and/or blocked gullies (see Figures 2 and 4). With changing climate patterns, it is expected that intense storms of this nature will become increasingly common. It is vitally important therefore that planning decisions recognise the potential risk that increased runoff poses to property and plan development accordingly so that future sustainability can be assured.
118. The overloading of the sewer system due to inflows exceeding the underground system capacity (i.e. resulting in surcharging) is a potential problem in any urban area. It is important to recognise that surface water networks are typically designed to cater for events up to a 1 in 30 year. Surface water flooding will occur when the sewer system is overloaded and/or a system blockage occurs.
119. The potential sources of flood risk within the Borough are explained more fully below.

### 6.2 Historical Flooding

120. Severe flooding affected the Boroughs along the River Thames, including Lewisham, on 6<sup>th</sup> January 1928 when the defences along the river were breached (refer Figure 4). Amongst other disaster locations, failure of a 25 metre stretch of embankment near Lambeth Bridge resulted in the death by drowning of fourteen people within basements. Four thousand people were made homeless as a direct result of this flooding event.
  - The last major flood in the Ravensbourne catchment was in September 1968, which was considered to have a return period of 100 years and caused flooding of residential and commercial properties. Flooding was observed within the Borough in 1977, however this was limited to the Quaggy and its tributaries. Flooding was also observed in 1992 and 1993, although this was largely confined once again to the Quaggy with relatively limited property flooding within the Ravensbourne catchment. There has been no tidal flooding of the Ravensbourne catchment since 1968, and is

now protected by the Thames Barrier.

121. The following statistics have been obtained from the Environment Agency work currently underway within the Ravensbourne catchment<sup>22</sup>:
- Fluvial flooding has not reached property threshold levels since 1993;
  - In most tributaries of the Ravensbourne there has been flooding of properties (since 2001) from surface water flooding. This has been the result of insufficient capacity of urban drainage systems and/or backwater effects on urban drains from high water levels in the watercourses. Partial culvert blockages may have also contributed to the flooding;
  - There is little evidence that groundwater flooding has affected properties apart from a limited number of house cellars and property gardens in the lower part of the catchment. It is also unclear if the source of flooding is the result of a high water table or if it originates from other sources (e.g. seepage from a nearby watercourse or from surface drainage).
122. Relatively few flooding incidents have occurred in more recent years. Anecdotal evidence provided by Thames Water noted that there were 26 occurrences of properties flooded by combined overloaded sewers in the last ten years in the BR 1 postcode area (refer Figure 4). However, this area extends outside of the borough boundary and may not provide an accurate assessment of flooding from this source within the Borough.

### 6.3 Fluvial Flood Risk

#### *River Thames*

123. The London Borough of Lewisham is bounded to the north by the River Thames. The Borough is situated within the lowermost reaches of the River Thames system, draining a catchment area of almost 5000 square miles. Historically the River Thames floodplain was substantially wider than it is today, and indeed the dense urban area of Greater London (including Lewisham) heavily constrains the passage of the river corridor as it winds its way towards the sea. Not surprisingly therefore, fluvial flooding from the River Thames does pose a risk to areas of London. High river levels within the lower reaches of the Thames are most likely to be evident when prolonged rainfall falls within the upper reaches of the catchment, affecting counties to the west of Greater London, as occurred during the summer of 2007.
124. The River Thames has been heavily modified over time with the growth of London, including the construction of raised defences along much of its length (within London). As a result, the direct risk to the London Borough of Lewisham as a result of fluvial flooding alone from the River Thames is virtually negligible. Should a fluvial flooding event within the upper catchment coincide with a particularly high tide in the lower reaches of the River Thames however, the London Borough of Lewisham is at risk. This is discussed further in the section below.

#### *River Ravensbourne & River Quaggy*

125. The risk of fluvial flooding through much of the Borough of Lewisham is dominated by the River Ravensbourne and River Quaggy. The river corridors are heavily constrained by urban development along much of their respective lengths, and (not surprisingly therefore) a risk of flooding is evident.
126. As described in Section 4.6 above, considerable modifications have been made to the river channels. In decades past, these improvements were often made in an attempt to increase land availability within town centres, canalising and/or culverting the rivers to get water away more quickly and more efficiently. As time passed however, it became increasingly evident that this was not a sustainable approach, particularly as flooding

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<sup>22</sup> Ravensbourne Flood Risk Management Strategy September 2005 Inception Report

began to pose an ever increasing risk to property and livelihood.

127. A change in 'philosophy' was adopted, and rivers were once again seen as a resource to be protected, rather than simply part of the wider drainage system. This is particularly evident within the River Ravensbourne catchment where both the Environment Agency and the Borough of Lewisham are now working to seek sustainable, planning led solutions to risk reduction, including (for example) Chinbrook Meadows. The current plan is to produce a Ravensbourne River Corridor Improvement Plan along the Ravensbourne. This will seek a design-led spatial improvement plan to ensure the principles of 'Making Space for Water' and the Blue Ribbon network are maximised, and proposed future developments (including regeneration) fit into a spatial improvement plan.
128. The potential risk of fluvial flooding from the Rivers Quaggy and Ravensbourne, delineated in accordance with the PPS25 flood zone definitions, is presented in Figure 2. A number of properties are potentially at risk of river flooding throughout the Borough, and the regeneration of these areas will require very careful consideration to ensure sustainability in future years.

## 6.4 Tidal Flood Risk

129. The primary risk to property and life from flooding within the northern proportion of the London Borough of Lewisham (adjoining the River Thames) is as a result of tidal activity. Considerable investment has been made in the provision of the Thames Tidal Defences (TTD) to protect Greater London (including Lewisham) from tidal flooding. It is essential to appreciate however that the flood defences are engineered structures that can only ever protect up to a point, they may malfunction, and they have a finite structural life. There will always therefore be a residual risk of flooding within the Borough, and this is explained further in the section below.
130. As highlighted earlier, the London Borough of Lewisham is situated in the lower reaches of the River Thames catchment, and the river is tidally influenced at this location. The primary risk of flooding within the London is as a result of a surge tide. A surge occurs when a weather system within the North Sea creates gale force winds that blow in a southerly direction through the narrow stretch of sea between Great Britain and the continent. A 'wedge' of water is created, increasing in depth as it progresses through the narrowing gap between the land masses towards the English Channel. Large tidally influenced river estuaries, particularly within the South East of England (including the River Thames), are susceptible to relatively large and rapid increases in river levels as the wave passes. Should this 'surge' coincide with a particularly high tide and/or fluvial flooding in the upper reaches of the catchment, the River Thames within London becomes in effect a 'basin' with water approaching in both directions.
131. The Thames Tidal Barrier was constructed specifically to prevent the tidal surge passing upstream into the built up areas of London. Not only does this (in conjunction with the raised River Thames flood defences) protect London from unusually high river levels as a result of a surge tide, but it also ensures that there is capacity in the river channel to safely store fluvial floodwaters that are travelling downstream from the upper catchment.
132. The future sustainability of London is clearly dependant to a large degree upon the retention of the River Thames Tidal Defences (TTD) in the longer term. Decisions surrounding investment of this nature in future years cannot be predicted with any certainty, and therefore it is imperative that planning decisions are taken with a clear understanding of the potential risks posed to property and life should things ultimately go wrong. This is the primary purpose of the following sections of the SFRA.

## 6.5 Risk to Life from Flooding (Flood Hazard)

133. Defra and the Environment Agency have recently collaborated to develop a document entitled 'Flood Risk to People' (FD2320). This provides guidance to aid in the review of flood hazard within the UK. The risk to life (as a result of flooding) within the Borough of Lewisham has been assessed to accordingly inform the allocation of land within the Borough for future development. A brief summary of the findings is presented below:

### Flood Hazard due to Flood Defence Failure

Flood defences are typically raised structures that alter natural flow patterns and divert floodwater away from areas of habitation in times of flooding. Raised defences exist along the Thames frontage, providing protection against tidal flooding, and along the River Ravensbourne and River Quaggy (refer Figure 3).

A failure of a raised flood defence could result in rapid inundation into the Borough, posing a potential risk to residents, pedestrians and property that may be in the path of the floodwaters. Deep, fast flowing water may threaten life, and this must be considered when planning future development. The accumulation of standing water as a result of breaching or overtopping also needs consideration. This can lead to flood risks associated with, for example:

- safe access and exit to properties through flood water;
- interference with essential services and infrastructure; and/or
- the inundation (without warning) of basement dwellings.

As part of the SFRA, hydraulic modelling was carried out to consider the velocity, depth and path of flood water should a failure of the defences occur (at any point along its length). The time within which flood waters inundate the Borough following a breach failure is also a key consideration of the breach modelling. The methodology used in the modelling is described in Appendices C and D. The use of this information in planning terms is outlined below.

### Sub-delineation of Zone 3a High Probability for Planning Purposes (River Thames)<sup>23</sup>

The northern portion of the London Borough of Lewisham is situated within Zone 3a High Probability, defended against flooding from the River Thames. There remains a residual risk of failure of these defences, and therefore it is essential that planning decisions are taken with due consideration to the scale (and variability) of this risk.

Two particular 'measures' of flood risk have been adopted to underpin the development of spatial planning and development control recommendations for the Borough.

The first is **flood hazard**, considering the potential risk to life should a failure of the flood defences occur. This is a measure of the flood depth and flow velocity, assessed as described in Appendix D. The adopted Flood Hazard zones are presented in Figure D.

The second is **rate of inundation**, considering the time available to warn residents and business owners of a pending flood following a failure of the River Thames defences. Once again, the method of assessment is provided in Appendix D, and

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<sup>23</sup> It is noted that, in some locations, the mapping appears to depict an immediate transition between 'significant' and 'low' flood hazard within Lewisham. This is simply due to the resolution of the printed mapping provided within the SFRA, and in all instances there is an intermediate zone of 'moderate' hazard that is not immediately visible at the adopted mapping scale. This will in no way influence the use of the SFRA maps for planning purposes.

the adopted Rate of Inundation zones are presented in Figure C.

For ease of reference, the rate of inundation has been superimposed onto the flood hazard map. This is provided as Figure E.

#### River Ravensbourne & River Quaggy Defences

A site walkover was carried out to identify those defences along the River Ravensbourne and River Quaggy that could potentially pose a direct risk to life should a sudden breach failure occur.

It was concluded that all raised defences along the Ravensbourne and the Quaggy are relatively short in stature (less than 1m in height), and therefore unlikely to collapse in a catastrophic manner, resulting in a sudden wave that may wash pedestrians off their feet. Consequently no dedicated breach modelling of this defence system has been carried out as part of the SFRA.

It is imperative however that any proposed development within close proximity of the defences consider the potential risk of breach failure and/or overtopping within a localised context as an integral part of the detailed Flood Risk Assessment. The location of the River Ravensbourne and River Quaggy defences is clearly marked in Figure 3.

#### Structural Integrity of Flood Defences

Finally, it is highlighted that the structural integrity of the existing flood defences is integral to the sustainability of development. It is recognised however that this will vary with time and proximity along the river frontage. Consequently it is essential that the detailed site based Flood Risk Assessment for all potential future development within defended areas of the Borough considers both the likelihood and consequence of defence failure near the proposed site. The current Environment Agency condition grades for the raised defences (for all rivers within the Borough) are presented in Figure 3.

### **Flood Hazard due to Reservoir (or Water Storage) Failure**

*PPS25 paragraph C9 states that “non-natural or artificial sources of flooding can include reservoirs, canals and lakes where water is retained above natural ground level, operational and redundant industrial processes including mining, quarrying and sand and gravel extraction, as they may increase floodwater depths and velocities in adjacent areas. The potential effects of flood risk management infrastructure and other structures also need to be considered. Reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure. The latter can happen suddenly resulting in rapidly flowing, deep water that can cause significant threat to life and major property damage. Industrial flooding can also occur when pumping ceases and groundwater returns to its natural level, for example in former mineral workings and urban areas where industrial water abstraction is reduced from its former rate. Some of this flooding may be contaminated.”*

The potential risk associated with artificial sources of flooding was investigated for SFRA purposes. It was determined that there are no known reservoirs and/or water storage facilities within (or near) the Borough of Lewisham that may pose a potential risk of flooding, either directly or in case of failure.

## 6.6 Localised Risk of Flooding

### Local Drainage Issues (Observed Flooding Incidents)

134. As discussed earlier, consultation has been carried out with a number of stakeholders to identify known and/or perceived problem areas. These problems are generally attributed to inundation resulting from (for example) culvert blockages and/or surface water flooding. Properties and infrastructure within the Borough have been subject to flooding in the recent past, as indicated in Figure 4.
135. Given the heavily urbanised character of much of the Borough, it is inevitable that localised flooding problems arising from under capacity drainage and/or sewer systems will occur, particularly given the mounting pressure placed upon ageing systems as a result of climate change. Furthermore, sewer systems are generally designed (in accordance with current Government guidance) to cater for the 1 in 30 year storm, and highway soakaways are generally designed for only 1 in 10 year storms. Storms over and above these design events will exceed the drainage system, resulting in overland flow, often in an uncontrolled manner (resulting in localised flooding). Input has been sought from Thames Water to pinpoint known and/or perceived problem areas relating to the sewer system, however the information provided is very general. In due course, surface water flood risk maps will be made available for the River Ravensbourne catchment as an outcome of the Ravensbourne Delivery Plan (refer Sections 5.3 and 7.3.4).
136. In the interim however, given the perceived scale of the potential 'local flood risk' within the Borough, it is essential that planning decisions are informed by a more detailed assessment (carried out in a local context). As part of the detailed site based FRA, it will be necessary for the developer to consider the potential risk of localised flooding from groundwater and/or surface water.
137. Incidents of historical flooding have been identified, however any location within the Borough may be susceptible to localised flooding, irrespective of whether or not they have flooded in the past. An overview of the geology and topography has been provided in Figures A and B, and these may be used as a tool to consider whether the proposed development site is (for example) situated within a local 'sink' that may be susceptible to localised ponding.

### Groundwater Flooding

138. A proportion of the Borough of Lewisham, away from the River Thames, overlays London Clay and consequently the risk of groundwater flooding will typically be very low. Areas adjoining the River Thames and River Ravensbourne corridors however are characterised by alluvium and 'river terrace deposits'. These are referred to as 'Thames Gravels' and there is evidence within adjoining Boroughs of groundwater flooding occurring some distance from the river as a result of water finding a pathway through the gravels during high river levels.
139. A number of incidents of observed flooding have been provided by the Environment Agency, referred to broadly by the Environment Agency as 'groundwater incidents' (refer Figure 2). At times however, incidents of groundwater flooding can be mistaken for flooding from other sources (or vice versa). The risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time however, and therefore it is not possible to sensibly develop a strategic map of 'groundwater risk' as part of the SFRA process. It is important to recognise that historical flooding is *not* a robust measure of the risk of flooding in future years.



140. Due to the high degree of variability when considering groundwater flooding, it is important to ensure that the potential risk of groundwater flooding to a property is considered within a local context. This is most appropriate at the development application stage (i.e. as part of the detailed Flood Risk Assessment).

## 6.7 Topography & Geology

### Topography

141. The topography London Borough of Lewisham falls gradually from north to south towards the River Thames. The River Ravensbourne traverses through the centre of the Borough in a relatively well defined river valley with land gently sloping towards the river corridor.
142. To the south of New Cross and St John, there are no distinct local low lying areas that may be particularly susceptible to localised ponding during periods of heavy rainfall. Within Deptford however (to the north of New Cross and St John) the area adjoining the River Thames is relatively low lying. Local 'sags' in the topography are evident, particularly Deptford Park and the Football Ground on Stockholm Road. Residential areas to the north of the railway line (around Reculver Road) are also low lying however, and may be susceptible to localised ponding should the underground drainage system be exceeded.
143. The topography of the London Borough of Lewisham is provided in Figure A.

### Geology

144. The geology of the London Borough of Lewisham is characterised by London Clay to the south, and river terrace deposits (Thames Gravels) to the north, and adjoining the River Ravensbourne. The impermeable nature of the soils within the south of the Borough (away from the river corridors) can increase the susceptibility of the area to surface water (or flash) flooding following periods of heavy rainfall. Immediately adjoining the River Thames, the deposits of gravel can lead to localised incidents of groundwater flooding. A lens of chalk is evident within the low lying area of Deptford, and this too may indicate a slightly higher susceptibility to possible groundwater flooding.
145. The geology of the Borough will heavily influence the functionality of Sustainable Drainage (SuDS) techniques, and should be carefully considered as part of the design process. In simple terms, some infiltration techniques including for example soakaways are unlikely to operate efficiently in areas overlaying impermeable soils. To the south of the Borough therefore, away from the river corridors, engineered solutions (including tanked on-site storage) may be more suitable.
146. An overview of the geology of the London Borough of Lewisham is provided in Figure B.

## 6.8 Impacts of Climate Change upon Flood Risk

147. No detailed modelling has been carried out within the Borough of Lewisham relating to the potential impacts of climate change, either with respect to the River Thames<sup>24</sup>, or the Rivers Ravensbourne and Quaggy. For planning purposes however, Zone 2

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<sup>24</sup> It is important to emphasise that the operation of the Thames Tidal Defences (TTD), including both the barrier and the raised flood defences, is expected to mitigate the potential impacts of climate change within London to a large extent. For design purposes therefore, developers should approach the Environment Agency for sensible predictions of flood levels incorporating climate change within the northern areas of the Borough of Lewisham

Medium Probability is considered a reasonable approximation of the likely extent of the High Probability flood zone in 100 years as a result of climate change.

148. **It is clear that climate change will not markedly increase the extent of river flooding within most areas of the Borough.** Consequently, few areas that are currently situated outside of Zone 3 High Probability will be at substantial risk of flooding in the foreseeable future. This is an important conclusion from a spatial planning perspective.
149. It is important to recognise that **those properties (and areas) that are currently at risk of flooding may be susceptible to more frequent, more severe flooding in future years.** It is essential therefore that the development control process (influencing the design of future development within the Borough) carefully mitigates against the potential impact that climate change may have upon the risk of flooding to the property.
150. For this reason, all of the development control recommendations set out below require all floor levels, access routes, drainage systems, infrastructure and flood mitigation measures to be designed *with an allowance for climate change*<sup>25</sup>. This provides a robust and sustainable approach to the potential impacts that climate change may have upon the Borough over the next 100 years, ensuring that future development is considered in light of the possible increases in flood risk over time.
151. Once again, it is emphasised that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river flooding, but it will also potentially increase the frequency and intensity of localised storms over the Borough. This may exacerbate localised drainage problems

## 6.9 Residual Risk of Flooding

152. It is essential that the risk of flooding is minimised over the lifetime of the development in all instances. It is important to recognise however that flood risk can never be fully mitigated, and there will always be a residual risk of flooding. This residual risk is associated with a number of potential risk factors including (but not limited to):
  - a flooding event that exceeds that for which the local drainage system has been designed;
  - the residual danger posed to property and life as a result of flood defence failure;
  - general uncertainties inherent in the prediction of flooding.
153. The modelling of flood flows and flood levels is not an exact science, therefore there are inherent uncertainties in the prediction of flood levels used in the assessment of flood risk. The adopted flood zones underpinning the Borough of Lewisham are largely based upon detailed river and/or breach modelling within the area. Whilst these provide a robust depiction of flood risk from a strategic perspective, all detailed modelling requires the making of core assumptions and the use of empirical estimations.
154. Taking a conservative approach for planning purposes therefore, the Environment Agency advises that finished floor levels are raised to 300mm above the 0.5% (200 year) peak design flood level (including climate change) when advising developers.

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<sup>25</sup> All elements of design must account for the potential impact of climate change in predicted peak design water levels, as highlighted in Section 7.4.4. The impacts of climate change should be assessed over the lifetime of the proposed development, and calculated in accordance with Appendix B of PPS25 (or as otherwise advised by the Environment Agency).

## 7 Sustainable Management of Flood Risk

### 7.1 Overview

155. An ability to demonstrate 'sustainability' is a primary government objective for future development within the UK. The definition of 'sustainability' encompasses a number of important issues ranging broadly from the environment (i.e. minimising the impact upon the natural environment) to energy consumption (i.e. seeking alternative sources of energy to avoid the depletion of natural resources). Of particular importance however is sustainable development within flood affected areas.
156. Recent history has shown the devastating impacts that flooding can have on lives, homes and businesses. A considerable number of people live and work within areas that are susceptible to flooding, and ideally development should be moved away from these areas over time. It is recognised however that this is often not a practicable solution. For this reason, careful consideration must be taken of the measures that can be put into place to minimise the risk to property and life posed by flooding. These should address the flood risk not only in the short term, but throughout the lifetime of the proposed development. This is a requirement of PPS25.
157. The primary purpose of the SFRA is to inform decision making as part of the planning and development control process, taking due consideration of the scale and nature of flood risk affecting the Borough. Responsibility for flood risk management resides with all tiers of government, and indeed individual landowners, as outlined below.

### 7.2 Responsibility for Flood Risk Management

158. There is no statutory requirement for the Government to protect property against the risk of flooding. Notwithstanding this however, the Government recognise the importance of safeguarding the wider community, and in doing so the economic and social well being of the nation. An overview of key responsibilities with respect to flood risk management is provided below.
159. The Greater London Authority (GLA) should consider flood risk when reviewing strategic planning decisions including (for example) the provision of future housing and transport infrastructure. The GLA is responsible for developing a Regional Flood Risk Assessment (RFRA) to inform the development (and distribution) of housing targets for Boroughs throughout the Greater London area.
160. The Environment Agency has a statutory responsibility for flood management and defence in England and Wales. It assists the planning and development control process through the provision of information and advice regarding flood risk and flooding related issues.
161. The Local Planning Authority is responsible for carrying out a Strategic Flood Risk Assessment. The SFRA should consider the risk of flooding throughout the Borough and should inform the allocation of land for future development, development control policies and sustainability appraisals. Local Planning Authorities have a responsibility to consult with the Environment Agency when making planning decisions.
162. Landowners & Developers<sup>26</sup> have the primary responsibility for protecting their land against the risk of flooding. They are also responsible for managing the drainage of their land such that they do not adversely impact upon adjoining properties.

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<sup>26</sup> Referred to also as 'landowners' within PPS25

163. The Environment Agency has developed a guide entitled “Living on the Edge” that provides specific advice regarding the rights and responsibilities of property owners, the Environment Agency and other bodies. The guide is targeted at owners of land situated alongside rivers or other watercourses, and is a useful reference point outlining who is responsible for flood defence, and what this means in practical terms. It also discusses how stakeholders can work collaboratively to protect and enhance the natural environment of our rivers and streams. This guide can be found on the Environment Agency’s website at [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk)

## 7.3 Strategic Flood Risk Management - The Environment Agency

### 7.3.1 Overview

164. With the progressive development of urban areas along river corridors, particularly during the industrial era, a reactive approach to flood risk management evolved. As flooding occurred, walls or embankments were built to prevent inundation to developing areas, often without consideration as to the effect that such limiters had on the ability of the watercourse to redistribute the risk of flooding elsewhere.
165. The Environment Agency (EA) in more recent years has taken a strategic approach to flood risk management. The assessment and management of flood risk is carried out on a ‘whole of catchment’ basis. This enables the Environment Agency to review the impact that proposed defence works at a particular location may have upon flooding at other locations throughout the catchment.
166. A number of flood risk management strategies are underway within the region, encompassing the large river systems that influence flood risk within the Borough of Lewisham. A brief overview of these investigations is provided below.

### 7.3.2 Thames Catchment Flood Management Plan (CFMP)

167. A CFMP is being developed for the River Thames catchment. A consultation summary document has been provided outlining the main messages from the CFMP (January 2007) as follows.

*“One of the Environment Agency’s main goals is to reduce flood risk from rivers and the sea to people, property and the natural environment by supporting and implementing government policies.*

*Flooding is a natural process – we can never stop it happening altogether. So tackling flooding is more than just defending against floods. It means understanding the complex causes of flooding and taking co-ordinated action on every front in partnership with others to reduce flood risk by:*

- *Understanding current and future flood risk;*
- *Planning for the likely impacts of climate change;*
- *Preventing inappropriate development in flood risk areas;*
- *Delivering more sustainable measures to reduce flood risk;*
- *Exploring the wider opportunities to reduce the sources of flood risk, including changes in land use and land management practices and the use of sustainable drainage systems.*

*Catchment Flood Management Plans (CFMPs) are a planning tool through which the Agency aims to work in partnership with other key decision-makers within a river catchment to explore and define long term sustainable policies for flood risk management. CFMPs are a learning process to support an integrated approach to land use planning and management, and also River Basin Management Plans under the Water Framework Directive.<sup>27</sup>*

168. Four over-arching key messages have been highlighted by the CFMP:
- Flood defences cannot be built to protect everything;
  - Climate change will be the major cause of increased flood risk in the future;
  - The floodplain is our biggest asset in managing flood risk;
  - The ongoing cycle of development and urban regeneration is a crucial opportunity to manage flood risk.
169. Specific messages have been provided for characteristic reaches along the River Thames, River Lee and all of their tributaries. The Ravensbourne and The Quaggy are classified as 'developed floodplain with little open space and often concrete river channels'. The messages that apply here are:
- Options to reduce the probability of flooding are highly constrained in these catchments. There is significant flood risk from a variety of sources and the rivers have been significantly altered.
  - We need to change the character of the urban footprint through re-development so that the consequences of flooding are reduced by better layout and a greater resilience to flooding.
  - In most areas we need to change the character of the urban area through re-development before we can introduce measures to reduce the probability of flooding that will be sustainable. For example, re-creating river corridors so that there is space for the river to flow and flood more naturally.
170. The CFMP also provides more detailed messages for smaller 'Policy Units' across Thames region. The visions and objectives for the Ravensbourne Policy Unit (which includes The Quaggy) are:
- To change the character of the urban floodplain through re-development. This should reduce the consequences of flooding whilst supporting the regeneration, modernisation and growth of communities. The consequences of flooding can be reduced by re-establishing river corridors so that urban areas can better accommodate flooding through set back from the river (location and layout) and the buildings are more resilient to flooding (design). In the long-term this should be achievable through re-development. It must be recognised that this is a long-term objective.
  - To naturalise the river where practical by removing culverts, trash screens, artificial channel and bank lining where possible. This will contribute to reducing the maintenance burden in the future by removing unnecessary structures and improving the river environment.
  - Safeguard existing open space (for example, by continuing with flood compatible land use such recreation) so that the opportunity to attenuate water will still be there in the future.
  - Continue to reduce the impact of low order flooding in urban areas (up to a 10% to 20% AEP flood – 1 in 10 to 1 in 5 year return period) by maintaining conveyance where it both effective and sustainable to do so. In the Ravensbourne this is primarily in established residential areas.

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<sup>27</sup> Catchment Flood Management Plans – Volume 1 (Guidance), Version 1.0, July 2004

- The river is seen more as a community asset, reducing the level of fly-tipping but continuing to enforce where it is effective and necessary.
  - Develop further technological solutions to flood warning.
  - To gain a more complete understanding of surface water and drainage related flooding so that any future improvements are part of a wider strategy for addressing these sources of flooding. A Surface Water Management Plan (SWMP) or Integrated Urban Drainage Plan (IUDP) should define the future approach. This is important in this policy unit because of both the existing and future risk.
  - Continue to maintain the Quaggy Flood Alleviation scheme.
  - Where it is most effective, progress options to reduce flood risk in the long-term. This could be to manage the probability of flooding (for example through defences at Deptford), or more to manage the consequences (for example through resilience). Option selection should be based on what is most effective and sustainable and not short-term factors.
171. The following key message has been provided by the Environment Agency for the Ravensbourne catchment (January 2008):

*"It is also important to recognise that in the Ravensbourne catchment, redevelopment and regeneration offer a crucial opportunity to reduce flood risk. Through regeneration we want to achieve resilient buildings, more open and naturalised watercourses, more flood compatible site layouts following redevelopment and continued flood compatible uses of existing open space.*

*Where redevelopment and regeneration is happening along watercourses, it will need to focus on site layout to recreate a river corridor. There may also be opportunities to develop flood storage in some of the existing open space and parkland within the catchment (for example the Quaggy Flood Alleviation scheme). Irrespective of local circumstances, all redevelopment should be resilient to flooding."*

172. The CFMP also provides strategic messages for a number of tributaries of the River Thames, amongst which is the Ravensbourne. The stated objectives and visions for the **Ravensbourne Policy Unit** provided in Appendix A.
173. These policies succinctly reinforce the over-arching objectives of PPS25, i.e. it is important that Local Authorities seek to restrict development within flood affected areas, protecting the natural floodplain wherever possible.

### 7.3.3 Thames 2100 Strategy (TE2100)

174. The Environment Agency's Thames Estuary 2100 (TE2100) project is currently developing a strategic plan for managing flood risk in the River Thames estuary to the year 2100. It covers the areas bordering the River Thames from the estuary upstream to Teddington Lock (Richmond upon Thames) where the tidal influence ends.
175. The following quotation has been provided by the EA to describe some key findings and messages from the TE2100 project so far (December 2007):

*"The Thames Barrier was designed to provide a high standard of protection to London to the year 2030. Our studies confirm that the Thames Barrier will continue to provide a high standard of protection beyond 2030, and with some improvements and additional supporting measures could still be providing the same high standard of protection to London at the end of the century.*

*The existing defences are very effective and appear to have a greater safety margin than previously understood.*

*As well as changing the way we manage our assets up to 2030, the short-term emphasis will also be on the way we reduce the consequences of flooding through floodplain management. The rigorous implementation of Planning Policy Statement 25 (Development and Flood Risk) for new development and regeneration in the Thames Gateway is necessary to reduce the cost and risk to life impacts of any flood.*

*Regeneration initiatives such as the Thames Gateway can provide real opportunities for reducing flood risk by factoring-in flood risk at early planning stage in a development and ensuring the 'Avoid, 'Prevent, Manage' hierarchy of flood risk management planning is maintained.*

*The Government's PPS25 clearly states that one of the duties of Planning Authorities is to safeguard sites for flood storage. A key objective of our stakeholder communications is therefore to ensure that the emerging findings of the TE2100 project are made available in an accessible format to Regional and Local Planning Authorities and decision-makers.*

*We have identified five potential flood storage sites and eight potential habitat replacement and compensation sites. In addition, other sites may become available in areas where existing developments come to the end of their lives. This consultation will provide essential feedback on the viability and acceptability of these 'accommodation spaces' being used as part of an integrated estuary management plan.*

*If globally we fail to control climate change there will come a time when the only option for managing flood risk in the Thames Estuary is extreme engineering or major relocation of vulnerable populations. Work to understand our limits to adaptation suggest that it would prove extremely challenging to tackle estuary water levels beyond a 5 metres mean sea-level rise. However, our studies show that we have time to combat the causes of climate change. If we can 'buy' 50 to 70 years for the existing flood management system this may be sufficient time for global efforts to bring about a real change in climate change mitigation measures."*

#### **7.3.4 Ravensbourne Delivery Plan**

176. The risks of flooding (from all sources) have been considered within the River Ravensbourne catchment. A detailed Delivery Plan is subsequently being developed, highlighting tangible (prioritised) actions that ultimately will reduce the risk of flooding within the catchment into the future. The Delivery Plan is being led by the Environment Agency, however importantly the study has sought to engage wider stakeholders including the Local Authorities and Thames Water.
177. The Delivery Plan will provide key actions not only for those responsible for improving critical infrastructure that will reduce the likelihood of flooding from rivers and the surface water drainage system. It will also target improved community education and awareness, and development control, seeking to reduce the *impact* that flooding may have when it occurs.
178. It is important that the Ravensbourne Delivery Plan is entrenched in Lewisham planning policy, influencing both planning decisions and development design. For this reason, it is recommended that the SFRA is reviewed following the completion of the Delivery Plan, ensuring the use of the best available information (e.g. surface water flood risk maps) and consistent DC recommendations. It is understood that the Ravensbourne Delivery Plan will be completed in late 2008.

## 7.4 Planning & Development Control – London Borough of Lewisham

### 7.4.1 Planning Solutions to Flood Risk Management

179. The risk of flooding is most effectively addressed through *avoidance*, which in very simple terms equates to guiding future development (and regeneration) away from areas at risk. Development that is sustainable for future generations is imperative, and it is widely recognised that the risk of flooding cannot be considered in isolation. There are many tests and measures of ‘sustainability’ that must be weighed in the balance when locating and designing future development.
180. PPS25 endeavours to guide Local Planning Authorities in this decision making process, and the Sequential and Exception tests underpin the method by which flood risk should be taken into consideration as part of the planning process. The application of these tests within the London Borough of Lewisham (by the Council) is outlined below.

#### The Sequential Test

181. Historically urbanisation has evolved along river corridors, the rivers providing a critical source of water, food and energy. This leaves many areas of England with a legacy of key urban centres that, due largely to their close proximity to rivers, are at risk of flooding.
182. The ideal solution to effective and sustainable flood risk management is a planning led one, i.e. steer urban development away from areas that are susceptible to flooding. PPS25 advocates a sequential approach that will guide the planning decision making process (i.e. the allocation of sites). In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. Only if it can be demonstrated that there are no suitable sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated. This sequential approach is referred to as **The Sequential Test**, and is summarised in Figure 4.1 of the PPS25 Development and Flood Risk Practice Guide (June 2008).

**It is absolutely imperative to highlight that the SFRA does not attempt, and indeed cannot, fully address the requirements of the PPS25 Sequential Test.** As highlighted in Section 7.4.1 and Figure 4.1 of the Practice Guide, it is necessary for the Council to demonstrate that sites for future development have been sought within the lowest flood risk zone (i.e. Zone 1 Low Probability). Only if it can be shown that suitable sites are not available within this zone can alternative sites be considered within the areas that are at greater risk of possible flooding (i.e. Zone 2, and finally Zone 3).

183. As indicated by Figure 4.1 of the Practice Guide, PPS25 stipulates permissible development types. This considers both the degree of flood risk posed to the site, and the likely vulnerability of the proposed development to damage (and indeed the risk to the lives of the site tenants) should a flood occur.
184. Wherever possible, the Council should restrict development to the permissible land uses summarised in PPS25 Appendix D (Table D2). These are replicated in Appendix E of this report for ease of reference. This may involve seeking opportunities to ‘swap’ more vulnerable allocations at risk of flooding with areas of lesser vulnerability that are situated on higher ground.



185. It is important to recognise that the principles of the sequential approach are applicable throughout the planning cycle, and refer equally to the forward planning process (delivered by Council as part of the LDF) as they do to the assessment of windfall sites. Where windfall sites come forward for consideration, it is essential that the developer to consider the planning 'need' for the proposed site (adopting a sequential approach in accordance with PPS25). The Council will assist where possible with supporting information. The detailed FRA will be required to demonstrate the careful and measured consideration of whether indeed there is an alternative site available within an area of lesser flood risk, in accordance with the PPS25 Sequential Test.

### **The Exception Test**

186. A proportion of the Borough of Lewisham is situated within PPS25 Zone 3. This is a particularly vibrant part of London and future investment and regeneration is paramount. Prohibiting future residential development in these areas is likely to have a detrimental impact upon the economic and social welfare of the existing community, an consequently there are clearly other non-flooding related planning 'needs' that warrant further consideration of these areas. Given that this is the case, following the application of the Sequential Test, the Council and potential future developers are required to work through the **Exception Test** (PPS25 Appendix D) where applicable. For the Exception Test to be passed:
- *"It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage, the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal;*
  - *the development should be on developable, previously development land or if it is not on previously developed land, that there are no reasonable alternative sites on previously development land; and*
  - *a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall."*
187. The first two points set out in the Exception Test are planning considerations that must be adequately addressed. A planning solution to removing flood risk must be sought at each specific location in the initial instance, seeking to relocate the proposed allocation to an area of lower flood risk (i.e. Zone 1 Low Probability or Zone 2 Medium Probability) wherever feasible.
188. The Lewisham SFRA has been developed to inform the Sequential Test. It will be the responsibility of the Council to carry out the Sequential Test on the basis of this information, allocating potential sites for future development accordingly. Furthermore, the developer will be required to demonstrate within the detailed Flood Risk Assessment that the Sequential Test has been applied, and (where appropriate) that the risk of flooding has been adequately addressed in accordance with PPS25.
189. The management of flood risk throughout the Borough must be assured should development be permitted to proceed, addressing the third critical element of the Exception Test. The SFRA has provided specific recommendations that ultimately should be adopted as design features, with evidence provided of how they will be fulfilled prior to permission being granted for all future development. It is the responsibility of the prospective developer to build upon these recommendations as part of a detailed Flood Risk Assessment to ensure that the specific requirements of PPS25 can be met.
190. An overview of flood risk throughout the Borough has been provided in Section 6 and the adjoining flood risk maps. **Future planning decisions should consider the spatial variation in flood risk across the Borough, as defined by the delineated flood zone that applies at the specified site location, and apply the recommendations provided below accordingly.** It is reiterated that PPS25 applies

equally to both allocated sites identified within the emerging LDF and future windfall sites.

#### **7.4.2 A Proactive Approach – Positive Reduction of Flood Risk through Development**

191. It is crucial to reiterate that PPS25 considers not only the risk of flooding posed to new development. It also seeks to positively reduce the risk of flooding posed to existing properties within the Borough. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within the Borough.
192. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the Borough, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should not be seen as an onerous requirement, and indeed if integrated into the design at the conceptual stage, will place no added demands upon the development and/or planning application process.
193. Possible risk reduction measures for consideration may include the following:
  - The integration of SuDS to reduce the runoff rate from the site;
  - A change in land use to reduce the vulnerability of the proposed development;
  - A reduction in the building platform area;
  - The raising of internal floor levels and flood proofing (within existing buildings) to reduce potential flood damage;
  - The rearrangement of buildings within the site to remove obstructions to overland flow paths;
  - The placement of buildings to higher areas within the site to limit the risk of flood damage;
  - The integration of landscaping for flood storage and flood resilience
194. It is recommended that a clear statement is requested within each and every detailed FRA that concisely summarises how a reduction in flood risk has been achieved within the proposed (re)development. This may be specified as (for example) a reduction in flow from the site, a reduction in water levels within (or adjacent to) the site, or a reduction in the consequences of flooding.

#### **7.4.3 Localised Flood Risk within the Planning Process**

195. The PPS25 Practice Guide advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. The local drainage related problems identified within the Lewisham SFRA are generally localised, and relate to historical incidents, the source of which is often somewhat uncertain. It is important to recognise therefore that these cannot be adopted as a measure of 'risk' of future localised flooding, but rather problems that have occurred due to a particular set of local circumstances in the past (for example, the blockage of a local gully inlet). These may or may not reoccur. More importantly however, areas that have not flooded previously can certainly not assume that (for this reason alone) they will not be affected in future years.
196. From a spatial planning perspective therefore, it is considered unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past. It is essential however not to overlook the potential risk of localised flooding during the design process. Whilst the incidents that have been identified will typically not result in widespread damage or disruption, a proactive approach to risk reduction through design can mitigate the potential for damage, both to the

development itself and elsewhere. Specific development control recommendations have been provided accordingly.

**7.4.4 Spatial Planning & Development Control Recommendations**

Policy Response	PPS25 Flood Zone							Zone 2 Medium Probability	Zone 1 Low Probability
	Zone 3b Functional Floodplain		Zone 3a High Probability			Zone 2 Medium Probability	Zone 1 Low Probability		
			RIVER RAVENSBOURNE & RIVER QUAGGY (refer Figure 3)		RIVER THAMES (refer Figure D)				
Developed	Undeveloped	Undefended	Defended	Extreme & Significant Hazard	Medium Hazard	Low Hazard			
<b>SPATIAL PLANNING RECOMMENDATIONS</b>									
<b>Important Considerations</b>	It is important to recognise that, within Zone 3b Functional Floodplain, 'developed land' relates solely to existing buildings that are impermeable to flood water. The undeveloped land surrounding these buildings are important flow paths and/or flood storage areas.	Future development within Zone 3b Functional Floodplain (Undeveloped) can only be considered following application of the Sequential Test	Future development within Zone 3a High Probability can only be considered following application of the Sequential Test	Future development within Zone 3a High Probability can only be considered following application of the Sequential Test	Future development within Zone 3a High Probability can only be considered following application of the Sequential Test	Future development within Zone 3a High Probability can only be considered following application of the Sequential Test	Future development within Zone 2 Medium Probability can only be considered following application of the Sequential Test	It is important to recognise that sites within Zone 1 may be susceptible to flooding from other sources. Development may contribute to an increase in flood risk elsewhere if not carefully mitigated	
	It should be recognised that property situated within Zone 3b Functional Floodplain will be subject to frequent flooding, on average, no less than once in every 20 years. There are clear sustainability implications to be considered in this regard, and it is highly questionable whether insurance against flooding related damages will be available in the longer term.						Areas of Zone 2 and Zone 1 that may be surrounded by flooding in case of a breach (e.g. Deptford) must ensure site specific emergency evacuation procedures are in place to ensure that the risk to life is minimised should a flood occur. Coordination with the emergency services will be required in the event of a flooding emergency.		
	Future development within Zone 3b Functional Floodplain (Developed) can only be considered following application of the Sequential Test								
<b>Land Use (refer Section 7.4.1 &amp; Appendix E)</b>	Proactively seek a reduction in risk by reducing the vulnerability of the existing land use	Water Compatible Development and Essential Infrastructure	Land use should be restricted to Water Compatible or Less Vulnerable development. More Vulnerable development may only be considered if Exception Test can be passed	Land use should be restricted to Water Compatible or Less Vulnerable development. More Vulnerable development may only be considered if Exception Test can be passed	Land use should be restricted to Water Compatible, Less Vulnerable or More Vulnerable development. Highly Vulnerable development may only be considered if Exception Test can be passed	No restrictions			

Policy Response		PPS25 Flood Zone									
		Zone 3b Functional Floodplain		Zone 3a High Probability					Zone 2 Medium Probability	Zone 1 Low Probability	
				RIVER RAVENSBOURNE & RIVER QUAGGY (refer Figure 3)		RIVER THAMES (refer Figure D)					
		Developed	Undeveloped	Undefended	Defended	Extreme & Significant Hazard	Medium Hazard	Low Hazard			
DEVELOPMENT CONTROL RECOMMENDATIONS											
Detailed Flood Risk Assessment (FRA)		Required	Required	Required	Required	Required	Required	Required	Required	Required for all sites > 1ha area	
Floor Level (refer Section 7.6.2)	More Vulnerable Development	Rate of Inundation <6hrs	Floor levels are to be situated a minimum of 300mm above the Q100 flood level, including climate change.	N/A	Floor levels are to be situated a minimum of 300mm above the Q100 flood level, including climate change.	Floor levels are to be situated a minimum of 300mm above the Q100 flood level, including climate change, assuming a breach of the river defences.	No residential development is permitted at ground floor level		Flood resilient design techniques should be adopted to mitigate the potential damage to property in case of flooding, guided by PPS25 Development and Flood Risk Practice Guide (June 2008)	Flood resilient design techniques should be adopted to mitigate the potential damage to property in case of flooding, guided by PPS25 Development and Flood Risk Practice Guide (June 2008)	No minimum level stipulated by PPS25
		6 to 12hrs					Ground floor levels should be situated 300mm above the Q200 plus Climate Change flood level, assuming a breach of the River Thames defences	Flood resilient design techniques should be adopted to mitigate the potential damage to property in case of flooding. Further guidance is provided in PPS25 Development and Flood Risk Practice Guide (June 2008)			
		Rate of Inundation >12hrs									
	Less Vulnerable Development	N/A					Flood resilient design techniques should be adopted to mitigate the potential damage to property in case of flooding, guided PPS25 Development and Flood Risk Practice Guide (June 2008)				
Site Access & Egress	More Vulnerable Development	Refer SFRA Appendix C. For residential property, dry access is to be provided above the Q100 flood level, including climate change. For commercial property, access must be 'safe' in accordance with Defra "Flood Risk to People" (FD2320 & FD2321)	N/A	Refer SFRA Appendix B. For residential property, dry access is to be provided above the Q100 flood level, including climate change. For commercial property, access must be 'safe' in accordance with Defra "Flood Risk to People" (FD2320 & FD2321)	Refer SFRA Appendix B. For residential property, dry access is to be provided above the Q100 flood level, including climate change, assuming a breach of the defences. For commercial property, access must be 'safe' in accordance with Defra "Flood Risk to People" (FD2320 & FD2321)	Access and egress routes should be designed to meet Environment Agency defined criteria, as set out in Appendix B. Only where this is not feasible, a dedicated 'safe haven' must be provided above the Q200 plus Climate Change flood level (assuming breach failure) to enable rapid escape should a failure of the defences occur. This may be provided in the form of a sheltered communal space within the building, accessed via internal stairs. It will be necessary to ensure that the safe haven is sufficient in size to safely house all residents. It is essential to ensure that the nominated evacuation route does not divert evacuees onto a 'dry island' upon which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event.		Site specific emergency evacuation procedures must be in place to ensure that the risk to life is minimised should a breach of the River Thames defences occur. Coordination with the emergency services will be required in the event of a flooding emergency	Site specific emergency evacuation procedures must be in place to ensure that the risk to life is minimised should a breach of the River Thames defences occur. Coordination with the emergency services will be required in the event of a flooding emergency	No minimum level stipulated by PPS25	
	Less Vulnerable Development		N/A			Site specific emergency evacuation procedures must be in place to ensure that the risk to life is minimised should a breach of the River Thames defences occur. Coordination with the emergency services will be required in the event of a flooding emergency					

Policy Response		PPS25 Flood Zone								
		Zone 3b Functional Floodplain		Zone 3a High Probability					Zone 2 Medium Probability	Zone 1 Low Probability
				RIVER RAVENSBOURNE & RIVER QUAGGY (refer Figure 3)		RIVER THAMES (refer Figure D)				
Developed	Undeveloped	Undefended	Defended	Extreme & Significant Hazard	Medium Hazard	Low Hazard				
<b>DEVELOPMENT CONTROL RECOMMENDATIONS (Continued)</b>										
<b>Basements (refer Figure C)</b>	Rate of Inundation <6hrs	No basements are permitted within Zone 3b Functional Floodplain	N/A	Basements must be restricted solely to non-residential uses within Zone 3a High Probability, with an internal access to above the Q100 plus climate change flood level. Flood resilient design techniques must be adopted, guided by PPS25 Development and Flood Risk Practice Guide (June 2008)	Basements must be restricted solely to non-residential uses within Zone 3a High Probability, with an internal access to above the Q100 plus climate change flood level, assuming a breach in the river defences. Flood resilient design techniques must be used for all basements (refer Section 7.7).	There is a potential risk to life where less than 6hours warning is available following a sudden breach of the River Thames defences. No basements permitted within this area.			Basements must be flood resistant, and must have an internal access to a higher floor (situated 300mm above the Q200 plus climate change flood level, assuming breach failure). Flood resilient design techniques must be used for all basements (refer Section 7.7).	No restrictions
	6 to 12hrs					Basements must be restricted solely to non-residential uses within the 'extreme' hazard zone. Basements must be protected with a continuous secondary fixed flood defence (refer Section 7.6.2), and be provided with an internal access to above the Q200 plus climate change flood level, assuming a breach of the River Thames defences. Flood resilient design techniques must be used for all basements (refer Section 7.7).	Basements must be flood resistant and have an internal access to above the Q200 plus climate change flood level, assuming a breach of the River Thames defences. Sleeping accommodation is not permitted at basement level. Flood resilient design techniques must be used for all basements (refer Section 7.7).	Basements must be flood resistant, and have an internal access to above the Q200 plus climate change flood level, assuming a breach of the River Thames defences. Sleeping accommodation is not permitted at basement level. Flood resilient design techniques must be used for all basements (refer Section 7.7).		
	Rate of Inundation >12hrs					Basements must be flood resistant, and must have an internal access to a higher floor (situated 300mm above the Q200 plus climate change flood level, assuming breach failure). Sleeping accommodation is not permitted at basement level.				
<b>Site Runoff (refer Sections 6.7 &amp; 7.6.3)</b>		Implement SuDS to ensure that a reduction in site runoff is achieved, reducing run-off rates by at least 50% over current levels. Any SuDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.								
<b>Buffer Zone</b>		A minimum buffer zone must be provided to 'top of bank' within sites immediately adjoining the River Thames. Advice must be sought from the Environment Agency at an early stage.								
<b>Other</b>		Ensure that the proposed development does not result in an increase in the risk of flooding (from all sources) within adjoining properties. This may be achieved by ensuring (for example) that the existing building footprint is not increased, that overland flow routes are not truncated by buildings and/or infrastructure, or hydraulically linked compensatory flood storage is provided within the site (or upstream)								



## 7.5 SFRA Interpretation

197. The spatial variation in flood risk across the Borough is depicted in the adjoining maps, and described below. The Lewisham SFRA should be used by both the Council and prospective developers to meet their obligations under PPS25 throughout the planning cycle. Instructions for use are provided below:

### London Borough of Lewisham (Forward Planning)

Figures 2 and 3 provides an overview of the spatial variation in fluvial flood risk throughout much of the Borough, originating from the River Ravensbourne and River Quaggy. It is necessary to adopt a sequential approach when considering where land should be allocated for future development, and this is described in Section 7.4. This figure should be used to inform this sequential approach. Further more detailed descriptions of flood risk in a more localised context are provided in Appendix F and on Figure C. Furthermore, PPS25 provides clear guidance on permissible land use within areas potentially at risk from flooding, and this too is discussed in Section 7.4.

A proportion of the Borough of Lewisham (situated adjacent to the River Thames) is defended however, and therefore primary risk of flooding within these areas is a residual risk (i.e. to be realised only should there be a failure of the River Thames defences). Given that this is the case therefore, it is important that a more robust assessment of the 'real' risk to property and life is considered, and the planning decisions taken accordingly. Figures C to E provide an overview of the variation in flood hazard within these defended (River Thames) areas of the Borough. It is intended that this information should be used for reference purposes as part of the design process. The Council should exercise a sequential approach within Zone 3a High Probability, steering more vulnerable development away from areas of highest hazard. Section 7.4.4 provides further advice in this regard.

Whilst there is no particular constraint placed upon land use within areas of Zone 1 Low Probability within the Borough, it is strongly recommended that the Council takes due consideration of flooding from other sources (i.e. non fluvial). Areas that have previously flooded from localised and non fluvial sources are depicted in Figure 4. Many of these localised sources of flooding within Lewisham can be effectively managed through the design process, however it is recommended that advice is taken from the Environment Agency to ensure that the severity of the local issue that may affect (or be exacerbated by) the proposed allocation is fully appreciated.

### London Borough of Lewisham (Development Control) & Developers

It is important that the potential risk of flooding is considered as an integral part of all proposed development within the Borough. Figure 2 (fluvial flooding from the Ravensbourne and Quaggy) and Figures C to E (River Thames) provide a measure of the severity of flooding within the proposed development site. Further more detailed descriptions of flood risk in a more localised context are provided in Appendix F. These should be used to trigger a more detailed assessment of flood risk related issues within the site, as described in Section 7.4 and Section 7.6. Within defended areas<sup>28</sup>, a detailed assessment of the potential impact of breach failure and/or defence overtopping will also be required.

The assessment of localised flooding related issues is imperative for all proposed development, irrespective of its location and/or scale within the Borough, and the SFRA provides some helpful tools to assist in this regard:

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<sup>28</sup> The Environment Agency has prepared a dedicated map layer referred to as 'Areas Benefitting from Defence' as depicted in [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk). This relates purely to areas defended from flooding from the River Thames however, and does not include the River Ravensbourne and/or River Quaggy defences. Areas benefitting from defences on the River Ravensbourne can be seen by referring to Figure 3. Early advice should be taken from the EA as to whether or not a breach assessment is required



- Figure 4 provides an indication of areas that have been susceptible to localised flooding historically. This is not a comprehensive record of flooding, and relies upon community reports of flooding made to the Council(s). It is a good indication of areas that may be susceptible however, and reiterates the importance of considering flood risk related issues in areas that are outside of the designated PPS25 flood zones.
- Figures A and B provide an overview of the topography and geology of the Borough. The detailed FRA should use this information to assess (in a site based context) the potential risk of localised ponding, flash flooding and/or inundation from groundwater.

## 7.6 Detailed Flood Risk Assessment (FRA) – The Developer

### 7.6.1 Scope of the Detailed Flood Risk Assessment

198. As highlighted above, the SFRA is a strategic document that provides an overview of flood risk throughout the area. It is imperative that a site-based Flood Risk Assessment (FRA) is carried out by the developer for all proposed developments, and this should be submitted as an integral part of the planning application.
199. The FRA should be commensurate with the risk of flooding to the proposed development. For example, where the risk of flooding to the site is negligible (e.g. Zone 1 Low Probability), there is little benefit to be gained in assessing the potential risk to life and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site does not exacerbate flooding lower in the catchment. The particular requirements for FRAs within each delineated flood zone are outlined below.
200. Proposed Development within Zone 3a High Probability & Zone 3b Functional Floodplain (existing developed areas)

All FRAs supporting proposed development within Zone 3b Functional Floodplain (existing developed areas only) and Zone 3a High Probability should include an assessment of the following:

  - The vulnerability of the development to flooding from other sources (e.g. surface water drainage, groundwater) as well as from river flooding. This will involve discussion with the Council and the Environment Agency to confirm whether a localised risk of flooding exists at the proposed site.
  - The vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change), i.e. maximum water levels, flow paths and flood extents within the property and surrounding area. *Within defended areas of the Borough<sup>29</sup>, flood levels (underpinning the design of a development) should be determined assuming a breach of the raised flood defences.* Two dimensional hydraulic modelling by suitably qualified engineers will typically be required to determine the risk of flooding to the site. This should be discussed with the Environment Agency at the earliest possible stage. The risk to property and life should be considered in accordance with FD2320 (Defra)<sup>30</sup>.
  - The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff and groundwater flow routes, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment,

<sup>29</sup> The Environment Agency has prepared a dedicated map layer referred to as 'Areas Benefitting from Defence' as depicted in [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk). This relates purely to areas defended from flooding from the River Thames however, and does not include the River Ravensbourne and/or River Quaggy defences. Areas benefitting from defences on the River Ravensbourne can be seen by referring to Figure C. Early advice should be taken from the EA as to whether or not a breach assessment is required.

<sup>30</sup> A 'debris factor' of 1 should be assumed within the urban environment

to be carried out by a suitably qualified engineer.

- A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable. Measures may include flood resistant and resilient design, escape/evacuation, effective flood warning and emergency planning (refer Section 7.4). Within defended areas, the structural integrity of the existing flood defences should be considered. It will be necessary to demonstrate that the structural conditions of the defences can be assured over the lifetime of the development.
- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum.
- Details of proposed sustainable drainage systems (SuDS) that will be implemented to mitigate any increase in runoff from the site as a result of future development. Any SuDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.
- The developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Borough.

#### 201. Proposed Development within Zone 2 Medium Probability

- For all sites within Zone 2 Medium Probability, a high level FRA commensurate with the level of risk posed to the site should be prepared based upon readily available existing flooding information, sourced from the EA. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed in accordance with the requirements set out in Section 7.4. *Within the defended areas<sup>31</sup> of the Borough, flood levels (underpinning the design of a development) should be determined assuming a breach of the raised flood defences;*
- The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered, and sustainable urban drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area.
- As part of the high level FRA, the developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Borough.
- Details of proposed sustainable drainage systems (SuDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SuDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.

#### 202. Proposed Development within Zone 1 Low Probability

For all sites greater than 1ha in area, a simple Flood Risk Assessment must be prepared. The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered. Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates. Any SUDS design must take due account of groundwater and geological conditions. Some infiltration techniques (including, for example, soakaways) are unlikely to be effective within areas overlying London Clay.

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<sup>31</sup> The Environment Agency has prepared a dedicated map layer referred to as 'Areas Benefitting from Defence' as depicted on [www.environment-agency.gov.uk](http://www.environment-agency.gov.uk). This relates purely to areas defended from flooding from the River Thames however, and does not include the River Ravensbourne and/or River Quaggy defences. Areas benefitting from defences on the River Ravensbourne can be seen by referring to Figure C. Early advice should be taken from the EA as to whether or not a breach assessment is required.

### 203. Liaison with the Environment Agency

To assist local planning authorities, the Environment Agency has produced standing advice to inform on their requirements regarding the consultation process for planning applications on flood risk matters. Full details of their Flood Risk Standing Advice can be found on the website: [www.pipernetworking.com](http://www.pipernetworking.com).

The Environment Agency is an excellent source of information to inform the development of the detailed FRA. The external relations team should be contacted as early as possible to source information relating to (for example) historical flooding, hydraulic modelling and topography (LiDAR). It is emphasised that the information provided within the SFRA is the best available at the time of writing. More up to date information may be available, and contact should always be made with the EA at an early stage to ensure that the detailed site based FRA is using the most current datasets, avoiding unnecessary re-work.

It is strongly recommended that a draft of the detailed FRA is provided to the EA for review and comment before submitted with the Planning Application, thereby reducing potentially costly delays to the planning process.

## 7.6.2 Raised Floor Levels (Freeboard) & Basements

204. The raising of floor levels within the highest risk areas of the Borough will ensure that the risk to life, and damage to property, is minimised. Where stipulated within Section 7.4 above, floor levels should be situated a minimum of 300mm above the predicted 1% (100 year) design flood level (plus climate change). Within defended areas adjoining the River Thames (refer Figures C to E), this should be taken as the 0.5% (200 year) design flood level (plus climate change) calculated assuming a breach of the raised flood defences. Specific advice should be sought in this regard from the Environment Agency prior to the commencement of any modelling. The height that the floor level is raised above flood level is referred to as the 'freeboard', and is determined as a measure of the residual risks.

### Basements

205. It is reiterated that basements within areas of the London Borough of Lewisham that fall within Zone 3a High Probability and/or Zone 2 Medium Probability must have a point of access that is situated above the 1% (100 year) or 0.5% (200 year) flood level, plus climate change, for the Rivers Ravensbourne & Quaggy, and the River Thames respectively. Specific development control requirements for basements are set out in Section 7.4.4.
206. It is particularly important to ensure that basements within areas situated within the 'extreme' and 'significant' hazard zones are provided within a 'continuous secondary fixed flood defence'. In practical terms, this may be a raised wall incorporated into the landscaping that will withstand the ponding of water (i.e. following a breach failure), and will prevent water surging into the basement area with little or no warning.

## 7.6.3 Sustainable Drainage Systems (SUDS)

207. SUDS is a term used to describe the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed reducing the rate of discharge from urban sites to greenfield runoff rates is one of the most effective ways of reducing and managing flood risk within the Borough. The integration of sustainable drainage systems into a site design can also provide broader benefits, including an

improvement in the quality of runoff discharged from the site, the capture and re-use of site runoff for irrigation and/or non potable uses, and the provision of greenspace areas offering recreation and/or aesthetic benefits. If planned properly at the outset, SUDS need not cost any more than 'conventional' drainage scheme.

208. SUDS may improve the sustainable management of water for a site by<sup>32</sup>:
- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
  - reducing volumes and the frequency of water flowing directly to watercourses or sewers from developed sites;
  - improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
  - reducing potable water demand through rainwater harvesting;
  - improving amenity through the provision of public open space and wildlife habitat;
  - replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained;
  - designs should, wherever possible, include landscaping for flood storage and flood resilience.
209. In catchment terms, any reduction in the amount of water that originates from any given site is likely to be small. But if applied across the catchment in a consistent way, the cumulative affect of a number of sites could be significant.
210. There are numerous different ways that SUDS can be incorporated into a development and the most commonly found components of a SUDS system are described in the following table<sup>33</sup>. The appropriate application of a SUDS scheme to a specific development is heavily dependent upon the topography and geology of the site (and its surrounds). Careful consideration of the site characteristics must be assured to ensure the future sustainability of the adopted drainage system.

Pervious surfaces	Surfaces that allow inflow of rainwater into the underlying construction or soil.
Green roofs	Vegetated roofs that reduce the volume and rate of runoff and remove pollution.
Filter drain	Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.
Filter strips	Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates.
Swales	Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter.
Basins, Ponds and Wetlands	Areas that may be utilised for surface runoff storage.
Infiltration Devices	Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways.
Bioretention areas	Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground

<sup>32</sup> Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

<sup>33</sup> Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

211. For more guidance on SUDS, the following documents and websites are recommended as a starting point:
- Interim Code of Practice for Sustainable Drainage Systems, National SUDS Working Group, 2004
  - Draft Planning Policy Statement 25, Annex F, Office of the Deputy Prime Minister, 2005
  - [www.ciria.org.uk/SUDS/](http://www.ciria.org.uk/SUDS/)
212. Furthermore, the Environment Agency (Thames Region) has issued best practice guidance for Sustainable Drainage Systems (October 2006), available from the Environment Agency development control teams. This provides a clear hierarchy for SUDS, reflecting the degree of sustainability offered by the SUDS application as captured in the table below.

Most Sustainable	SUDS technique	Flood Reduction	Water Quality Improvement	Landscape & Wildlife Benefit
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paving	✓	✓	
	Tanked systems - over-sized pipes/tanks - storms cells	✓		
	Least Sustainable			

213. Finally, Chapter 6 of the Mayor's Draft Water Strategy (Rainwater in London) sets out a hierarchy for management of urban runoff as below:
- "The Mayor proposes the following hierarchy for the drainage of rainwater:*
- *Store rainwater for use later*
  - *Use infiltration techniques, such as porous surfaces in non-clay areas*
  - *Attenuate rainwater in ponds or open water features for gradual release to a watercourse*
  - *Attenuate rainwater in tanks or sealed water features for gradual release to a watercourse*
  - *Discharge rainwater direct to a watercourse*
  - *Discharge rainwater to a surface water drain*
  - *Discharge rainwater to the combined sewer, as a last resort."*
214. It is recommended that developers are required to demonstrate that this hierarchy has been considered in the design of their stormwater management system.

## 7.7 Local Community Actions to Reduce Flood Damage

215. There will always be a residual risk of flooding, whether that be (for example) from an event that is more extreme than that considered, or whether as a result of a flood defence system that fails unexpectedly. Flood resistance and flood resilience may need to be incorporated into the design of buildings for this reason.

216. In all areas at risk of flooding, a basic level of flood resistance and resilience will be achieved by following good building practice and complying with the requirements of the Building Regulations 2000<sup>34</sup>. The difference between 'resilience' and 'resistance' is explained below:
- *Flood resistance*, or 'dry proofing', where flood water is prevented from entering the building. For example using flood barriers across doorways and airbricks, or raising floor levels.
  - *Flood resilience*, or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood.
217. Examples of both flood-resistant and flood resilient design are given in Improving the Flood Performance of New Buildings (Flood Resilient Construction), CLG (2007).
218. It is estimated that several hundred homes within the Borough are at risk of flooding. It is essential therefore to ensure a broad awareness with respect to flood risk, providing the community with the knowledge (and tools) that will enable them to help themselves should a flood event occur.
219. The following 'community based measures' are cost effective solutions that local communities may introduce to minimise the damage sustained to their own homes in the case of flooding. Further guidance is provided by the EA, Defra and CLG<sup>35</sup> (refer the National Flood Forum ([www.floodforum.gov.uk](http://www.floodforum.gov.uk))).
220. It is recommended that the Local Authority seek to proactively raise awareness within the community with respect to flooding (and indeed 'self help' flood risk reduction opportunities) through, for example, the circulation of a targeted newsletter to affected residents to coincide with the release of the Lewisham SFRA.

### 7.7.1 Flood Proofing

221. The 'flood proofing' of a property may take a variety of forms:

For new homes and/or during redevelopment

- Raising of floor levels

The raising of floor levels above the anticipated maximum flood level ensures that the interior of the property is not directly affected by flooding, avoiding damage to furnishings, wiring and interior walls. It is highlighted that plumbing may still be impacted as a result of mains sewer failure.

- Raising of electrical wiring

The raising of electrical wiring and sockets within flood affected buildings reduces the risks to health and safety, and reduces the time required after a flood to rectify the damage.

For existing homes

- Flood boards

The placement of a temporary watertight seal across doors, windows and air bricks to avoid inundation of the building interior. This may be suitable for relatively short periods of flooding, however the porosity of brickwork may result in damage being sustained should water levels remain elevated for an extended period of time. This may lessen the effectiveness of flood proofing to existing properties affected by flooding from larger river systems such as the Thames.

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<sup>34</sup> Office of Deputy Prime Minister (ODPM) – now Communities & Local Government (CLG)

<sup>35</sup> Improving the Flood Performance of New Buildings – Flood Resilient Construction (May 2007)

## 7.8 Emergency Planning

222. The Council is designated as a Category 1 Responder under the Civil Contingencies Act 2004. As such, the Council has defined responsibilities to assess risk, and respond appropriately in case of an emergency, including (for example) a major flooding event. The Council's primary responsibilities are<sup>36</sup>:
- a. *from time to time assess the risk of an emergency occurring;*
  - b. *from time to time assess the risk of an emergency making it necessary or expedient for the person or body to perform any of his or its functions;*
  - c. *maintain plans for the purpose of ensuring, so far as is reasonably practicable, that if an emergency occurs the person or body is able to continue to perform his or its functions;*
  - d. *maintain plans for the purpose of ensuring that if an emergency occurs or is likely to occur the person or body is able to perform his or its functions so far as necessary or desirable for the purpose of:*
    - i. *preventing the emergency,*
    - ii. *reducing, controlling or mitigating its effects, or*
    - iii. *taking other action in connection with it*
223. The SFRA provides a concise summary of the possible sources of flooding within the Borough, and may be used to inform the assessment of flood risk in response to the requirements of the Act.
224. The Environment Agency monitors river levels within the River Thames and the River Ravensbourne (refer Figure F). Based upon weather predictions provided by The Met Office, the Agency makes an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days). Where these predicted water levels are expected to result in the inundation of populated areas<sup>37</sup>, the Environment Agency will issue a series of flood warnings within defined flood warning areas, encouraging residents that are signed up to the service to take action to avoid damage to property in the first instance.
225. The Environment Agency advises that people and key infrastructure may be vulnerable at different stages of flooding:
- *before* – lack of preparedness – ensure people are aware (sign up to Flood Warnings Direct) infrastructure is protected or resilient;
  - *during* - property and infrastructure is flood-resistant, escape and access is appropriate, refuge areas are provided;
  - *after* – recovery is maximised - ensure emergency services can reach those most at risk/affected, no basement-only properties in areas of most flood risk, ensuring properties are properly flood-resilient.
226. As water levels rise and begin to pose a risk to life and/or livelihood, it is the responsibility of the emergency services to coordinate the evacuation of residents. This evacuation will be supported by the Council. It is essential that a robust plan is in place that clearly sets out (as a minimum):
- roles and responsibilities;
  - paths of communication;
  - evacuation routes;
  - community centres to house evacuated residents;
  - contingency plans in case of loss of power and/or communication.

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<sup>36</sup> Civil Contingencies Act 2004

<sup>37</sup> Restricted to those urban areas situated within Environment Agency flood warning zones

227. Coordination with the emergency services and the Environment Agency is imperative to ensure the safety of residents in time of flood. A relatively small proportion of the Borough is at risk of river flooding (as indicated by the shaded PPS25 flood risk zones in the adjoining maps). Flooding of this nature will typically occur following relatively long duration rainfall events, and consequently forewarning will generally be provided to encourage preparation in an effort to minimise property damage and risk to life. It is worth highlighting however that the benefits of flood warning are often compromised to a large degree by the lack of 'take up' within the local community. This emphasises the extreme importance of raising local awareness with respect to the potential risks of flooding.
228. Areas suffering from localised flooding issues will tend to be at greater risk. These areas are susceptible to 'flash' flooding, associated with storm cells that pass over the Borough resulting in high intensity, often relatively localised, rainfall. It is anticipated that events of this nature will occur more often as a result of possible climate change over the coming decades. Events of this nature are difficult to predict accurately, and the rapid runoff that follows will often result in flooding that cannot be sensibly forewarned. All urbanised areas are potentially at some degree risk of localised flooding due to heavy rainfall. The blockage of gullies and culverts as a result of litter and/or leaves is commonplace, and this will inevitably lead to localised problems that can only realistically be addressed by reactive maintenance.
229. To support the emergency planning process, Figure 5 depicts the locations of vulnerable sites and emergency services, and Figure E provides an indication of flood depths along key roads within the Borough following a breach of the River Thames defences. The emergency planning team (and indeed prospective developers) may use this information to identify routes that may be susceptible to flooding following particularly heavily rainfall and/or a failure of the River Thames defences.
230. Floodplain management and emergency response activities must have a focus on key infrastructure such as the underground network and other properties that are below sea level. Emergency planning would include refuge areas in vulnerable areas, and aim to increase the number of people who sign up to Flood Warnings Direct<sup>38</sup>. Key challenges include instilling a culture of flood preparedness in the resident and visitor population without damaging confidence in London.
231. It is important to reiterate that flood risk can be reduced by reducing both the probability and the *consequences* of flooding. If the probability is uncertain, the consequences can still be reduced by increasing flood awareness and flood preparedness, assisting members of the community to help themselves in case of flooding by providing forewarning of a flood event. Those at flood risk should be encouraged to sign up to the Environment Agency's Flood Warnings Direct.
232. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Lewisham SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

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<sup>38</sup> Environment Agency flood warning service



## 7.9 Insurance

233. Many residents and business owners perceive insurance to be a final safeguard should damages be sustained as a result of a natural disaster such as flooding. Considerable media interest followed the widespread flooding of 2000 when it became clear that the insurance industry were rigorously reviewing their approach to providing insurance protection to homes and businesses situated within flood affected areas. Not surprisingly, the recent widespread flooding of July 2007 has further exacerbated the discussion surrounding the future of insurance for householders and business owners situated within flood affected areas.

234. The following quotations are an extract from the Association of British Insurers (ABI) website, dated August 2007:

*“The UK is unique in offering flood cover as a standard feature of household and most business policies. Unlike much of Europe and worldwide, cover is widely available to the UK’s 23.5 million householders.*

*In the long term, this situation could worsen, unless we take action to reduce flood risk to people and property. Climate change will increase winter rainfall, the frequency of heavy rainfall, and sea levels and storm surge heights. With no change in Government policies or spending, climate change could increase the number of properties at risk of flooding to 3.5 million. Furthermore, continued pressure on land could mean even more new developments being situated in floodplains.*

*By spreading the risk across policy holders, insurance enables householders and businesses to minimize the financial cost of damage from flooding. In the modern competitive insurance market, premiums reflect the risks that customers face. This enables insurance to be offered at very competitive prices to customers living in low flood risk areas.*

*In 2003 ABI members agreed to extend their commitment to provide flood insurance to the vast majority of UK customers. The result of discussions between Government and insurers was a Statement of Principles, which aims to provide reassurance to the overwhelming majority of insurance customers living in the floodplain about the continued availability of insurance in future.*

*Individual property owners can do much to increase the resistance and resilience of their properties to flood damage - further information is available. ABI has issued a factsheet for property owners on a range of measures that could be taken by a homeowner to improve the resilience of their property to flood damage.”*

235. In summary, for the time being, residents and business owners can be assured that insurance will be available to assist in recovery following a flood event. It would appear fair to say however that the future availability of flood insurance within the UK will be heavily dependant upon commitment from the government to reduce the risk of flooding over time, particularly given the anticipated impacts of climate change. Investment is required in flood defence and improving the capacity of sewage and drainage infrastructure, however it is also essential to ensure that spatial planning decisions do not place property within areas at risk of flooding.

## 8 Conclusion & Recommendations

236. A number of properties within the Borough of Lewisham are at risk of flooding. The risk of flooding posed to properties within the Borough arises from a number of sources including river flooding, localised runoff and sewer flooding.

### Strategic Flood Risk Management (Environment Agency)

237. The Environment Agency's emerging TE2100 strategy for the Thames Estuary for the next 100 years includes the London Borough of Lewisham and highlights the following key messages:-
- *The present system of flood risk management provides a very high standard of protection.*
  - *Measures to maintain or reduce overall flood risk include raising defences (where possible), setting defences back from the river to make space for water and reducing the consequences of flooding. This may be achieved by increasing flood resilience and resistance of development and infrastructure, siting development in locations that are appropriate to the flood risk, raising flood awareness and preparedness, ensuring that emergency planning measures have been considered (including safe access and egress during a flood), and finally ensuring that the development is safe.*
  - *Land Use Planning and floodplain management have a fundamental role to play to prevent the build up of risk into the future.*
238. The Environment Agency's Thames Catchment Flood Management Plan (CFMP) goes on to highlight the important links between planning and flood risk management. In the Ravensbourne catchment:
- *Options to reduce the probability of flooding are highly constrained in these catchments. There is significant flood risk from a variety of sources and the rivers have been significantly altered.*
  - *We need to change the character of the urban footprint through re-development so that the consequences of flooding are reduced by better layout and a greater resilience to flooding.*
  - *In most areas we need to change the character of the urban area through re-development before we can introduce measures to reduce the probability of flooding that will be sustainable. For example, re-creating river corridors so that there is space for the river to flow and flood more naturally.*
  - *The most effective and sustainable approach to managing risk in the long-term is to change the character of the urban floodplain. In the long-term this provides the opportunity to link our management of the watercourse (channel, structures), floodplain (open space) to the redevelopment of the urban river corridor.*
  - The Environment Agency has invested heavily in assessing and addressing (at a strategic level) the risk of flooding within the Ravensbourne catchment. The TE2100 strategy for the Thames Estuary has established a preferred policy for the area encompassing the Borough of Lewisham, namely (Policy 5) "Take further flood risk management action to reduce the risk now and into the future, taking account of land use and climate change." A number of options have been identified to deliver this policy, and these rely heavily upon the engagement of key stakeholders, including the Council. These options are outlined in Appendix A.

### **Planning Response to Flood Risk (Lewisham Borough Council)**

239. Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out in accordance with PPS25, developed in close consultation with both the Council and the Environment Agency. The Borough has been broken down into zones of 'high', 'medium' and 'low' probability of flooding in accordance with PPS25, providing the basis for the application of the PPS25 Sequential Test.
240. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test. Specific planning recommendations have been provided for all urban centres within the Borough (refer Section 7.4).
241. Where other planning considerations must guide the allocation of sites and the Sequential Test cannot be satisfied, specific recommendations have been provided to assist the Council and the developer to meet the Exception Test. These should be applied as development control conditions for all future development (refer Section 7.4.4).
242. Council policy is essential to ensure that the recommended development control conditions can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the Borough with respect to flood risk management. It is recommended that supplementary planning guidance is developed to build upon emerging Council policy, in light of the suggested development control conditions presented by the Lewisham Borough SFRA.
243. Emergency planning is imperative to minimise the risk to life posed by flooding within the Borough. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the Lewisham SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.
244. The Environment Agency's Catchment Flood Management Plan also provides strategic messages for the River Ravensbourne (which can be found in Appendix A)<sup>39</sup>. These include:-
- All redevelopment adjacent to watercourses must be set back from the river
  - All redevelopment in the floodplain must be resilient to flooding and not rely on human intervention
  - All redevelopment must reduce the maintenance burden in the future by removing unnecessary structures and naturalise the river where practical by removing culverts, trash screens, artificial channel and bank lining where possible
  - Open space will continue to have flood compatible uses eg recreation so that as funding levels change, or the basis for allocating resources changes in the future, the opportunity to store water will still be there

### **A Living Document**

245. The SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Borough. A rolling programme of detailed flood risk mapping within the South East region is underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk within the Borough and may marginally alter predicted flood extents within Lewisham. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25, and future amendments to the PPS25 Practice Guide are anticipated.

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<sup>39</sup> Ravensbourne Policy Unit, Draft, July 2007

246. Given that this is the case, a periodic review of the Lewisham SFRA is imperative. It is recommended that the Lewisham SFRA is reviewed on a regular basis, and a number of key questions to be addressed as part of the SFRA review process (i.e. triggering whether or not a comprehensive review is required) are provided below. It is reiterated, as discussed in Section 7.3.4, that a review of the SFRA should be carried out in due course to integrate the findings and recommendations of the Ravensbourne Delivery Plan, currently under development by the Environment Agency.

#### Question 1

Has any flooding been observed within the Borough since the previous review? If so, the following information should be captured as an addendum to the SFRA:

- What was the mapped extent of the flooding?
- On what date did the flooding occur?
- What was the perceived cause of the flooding?
- If possible, what was the indicative statistical probability of the observed flooding event? (i.e. how often, on average, would an event of that magnitude be observed within the Borough?)
- If the flooding was caused by overtopping of the riverbanks, are the observed flood extents situated outside of the current Zone 3a? If it is estimated that the frequency of flooding does not exceed 1% (1 in 100) then the flooded areas (from the river) should be incorporated into Zone 3a to inform future planning decision making.

#### Question 2

Have any amendments to PPS25 or the Practice Companion Guide been released since the previous review? If so, the following key questions should be tested:

- Does the revision to the policy guidance alter the definition of the PPS25 Flood Zones presented within the SFRA?
- Does the revision to the policy guidance alter the decision making process required to satisfy the Sequential Test?
- Does the revision to the policy guidance alter the application of the Exception Test?
- Does the revision to the policy guidance alter the categorisation of land use vulnerability, presented within Table D2 of PPS25 (December 2006)?

If the answer to any of these coare questions is 'yes' then a review of the SFRA recommendations in light of the identified policy change should be carried out.

#### Question 3

Has the Environment Agency issued any amendments to their flood risk mapping and/or standing guidance since the previous policy review? If so:

- Has any further detailed flood risk mapping been completed within the Borough, resulting in a change to the 20 year, 100 year or 1000 year flood outline? If yes, then the Zone 3b and Zone 3a flood outlines should be updated accordingly.
- Has the assessment of the impacts that climate change may have upon rainfall and/or river flows over time altered? If yes, then a review of the impacts that climate change may have upon the Borough is required.
- Do the development control recommendations provided in Section 7.4 of the SFRA in any way contradict emerging EA advice with respect to (for example) the provision of emergency access, the setting of floor levels and the integration of sustainable drainage techniques? If yes, then a discussion with the EA is required to ensure an agreed suite of development control requirements are in place.

It is highlighted that the Environment Agency review the Flood Zone Map on a quarterly basis. If this has been revised within the Borough, the updated Flood Zones will be automatically forwarded to the Council for their reference. *It is recommended that only those areas that have been amended by the Environment Agency since the previous SFRA review are reflected in Zone 3 and Zone 2 of the SFRA flood maps.* This ensures that the more rigorous analyses carried out as part of the SFRA process are not inadvertently lost by a simple global replacement of the SFRA flood maps with the Flood Zone Maps.

#### Question 4

Has the implementation of the SFRA within the spatial planning and/or development control functions of the Council raised any particular issues or concerns that need to be reviewed as part of the SFRA process?.

## **APPENDIX A**

Key Messages from the Environment Agency  
River Thames CFMP  
**Ravensbourne Policy Unit**



## **APPENDIX B**

### **Safe Access & Egress Design Requirements (Environment Agency, June 2007)**





**'Safe' access and egress is to be designed to meet the following strict criteria:**

Developments within Zone 3a High Probability and Zone 2 Medium Probability, and are **NOT** offered protection from flood defences:

- Dry escape, above the 100 year flood level taking into account climate change, should be provided for all 'more vulnerable' (including residential) and 'highly vulnerable' development;
- 'Safe' should preferably be dry (above Q100 plus climate change) for all other uses such as educational establishments, hotels and 'less vulnerable' land use classifications.

Developments within Zone 3a High Probability and Zone 2 Medium Probability, and **ARE** offered protection from flood defences:

- 'Safe' access should preferably be dry for 'highly vulnerable' uses, situated above the Q200 plus climate change flood level, assuming a breach failure of the River Thames or River Ravensbourne defences;
- For all development, 'safe' access should incorporate the ability to escape (un-aided, and without passing through floodwaters) to a safe haven that is situated above the Q200 plus climate change water level, assuming a breach of the River Thames or River Ravensbourne defences.

**In all instances, it will be necessary to ensure that the London Borough of Lewisham Emergency Planning Team, and the emergency services (consulted via the Emergency Planning Team), accept the proposals.**

For *major 'highly vulnerable' development*, 'safety' will also need to be ensured through the development of a robust evacuation plan. This should clearly define routes to dry (i.e. 'unflooded') land. This may include routes through flood waters, providing the depth and speed of flow across the evacuation route are below the risk defined by the "some" threshold in 'Flood Risk to People' (Defra, FD2320)<sup>40</sup>.

For *infrastructure development*, 'safety' will also need to be ensured through the development of a robust evacuation plan. This should clearly define dry escape routes (above the 100 year plus climate change flood level) to dry (i.e. 'unflooded') land.

In exceptional circumstances, dry access (above the 100 year plus climate change flood level) for 'more vulnerable' and/or 'highly vulnerable' development may not be achievable. In these exceptional circumstances, liaison must be sought with the Environment Agency and the London Borough of Lewisham Emergency Planning Team to ensure that the safety of site tenants can be satisfactorily resolved.

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<sup>40</sup> Refer Defra Research Paper FD2320 'Flood Risks to People'



## **APPENDIX C**

# Breach Modelling Methodology



## **Breach Modelling**

The method used in the breach analysis was chosen to ensure a high level of accuracy when simulating a theoretical breach in raised defences. It was decided to dynamically link a simplistic 1D representation of the River Thames with a two dimensional representation of the floodplain developed using the TUFLOW 2D modelling package. The principal benefit of using a 2D model in this low-lying floodplain area is that the model determines the flow routes throughout the catchment.

### *1D Hydrologic model*

The 1D Hydrologic model Estry was used and physical dimensions of the river were estimated using map data and online sources. A conservative scenario was chosen to evaluate rapid inundation by using the hydraulic inflow into the model designed to replicate a water level lapping at the top of the defences (6m AOD).

### *2D TUFLOW*

The methodology adopted for the 1D/2D modelling was based on the approaches described by the TUFLOW modelling manual<sup>41</sup>, whereby the user sets up a model as a combination of 1D *Estry*, network domains linked to 2D TUFLOW domains using the hydrodynamic programme to form one model. The 1D model and the 2D TUFLOW were linked by “carving” through the 2D TUFLOW. The 1D domain lateral banks were defined as a weir allowing flood water to spill into the 2D TUFLOW model and vice versa.

### *2D Domain*

A low level LiDAR survey was commissioned by the Environment Agency in February 2003 along the study reach to provide the 2D model with acceptably accurate ground elevation data. The filtered LiDAR levels are distributed on a 1m grid for most of the study area; these have been used to inform the 4m grid TUFLOW model DTM as well as breaklines and bank crest elevation lines representing the boundaries between the 2D and 1D network domains.

The 2D domain contains the appropriate defence height in the form of “zIn” breaklines as TUFLOW fixed grid discretisation does not guarantee that the crest height for structures is picked up from the LiDAR DTM. The domain also includes a range of different roughness zones which alter the velocity and flow path depending on the land use. The buildings have been mapped and their roughness is assigned a value of 0.7n (Mannings roughness value). As the 2D DTM is based on filtered LiDAR data it can contain unnecessary obstructions to flow paths that do not occur in reality. These obstructions have been removed to ensure the accuracy of the flow paths, e.g.; through roads intersecting an embankment railway track.

### *Model Runs*

Once the 1D/2D model was linked and the necessary water levels were achieved the model was run with all defences in place with a crest height of 6m AOD. The results from this model run were used as “hot start” conditions for breach simulations. The breach locations have been selected based upon a visual assessment and consultation with Environment Agency personnel. These locations were selected on the basis of the height of the defence (>1m) and the accessibility to the public immediately behind the defence. Those locations in which an immediate risk to public safety was considered likely (as a result of a breach) were identified for breach analysis. These results were then ‘interpolated’ along the remainder of the defence line on the basis of local topography.

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<sup>41</sup> TUFLOW User Manual, GIS based 2D/1D Hydrodynamic Modelling, WBM Oceanics 2006

For planning purposes, the assessment of flood hazard has assumed a 'worst case' scenario in which the breach occurs when the water level in the river is lapping the top of the defence. This cannot strictly be tied directly to a particular design event within the Thames, however discussions with the Environment Agency have raised the following points:

- the top of the existing raised flood defences within Lewisham are generally assumed to be equivalent to (in the order of) the 0.1% (1000 year) peak tidal flood level;
- the difference in peak water level between events is very small (due in large part to the operation of the Thames Barrier).

In total, 9 separate breach sites were chosen which are shown on the adjoining maps. To ensure a worst case scenario, each model had their defences altered at those specific locations to instantaneously remove a 24m long section of defence. All of the breach models were run only for a 4 hour simulation, and a further simulation of 15 hours was carried out to better understand the flow paths with a prolonged breach (located near the Tate Modern within adjoining Southwark). TUFLOW provides multiple outputs and allows a Risk grid to be produced, defined as a function of velocity and depth. The results of the breach modelling are provided in the figures.

#### *Limitation of SFRA Breach Analysis*

It is important to recognise that the breach modelling carried out as part of the SFRA process is a strategic level assessment of flood hazard throughout the borough. A 'worst case' scenario has been adopted for planning purposes, providing a conservative assessment of risk. **It may be necessary for a more detailed review of flood hazard to be carried out as part of the detailed Flood Risk Assessment, and early advice should be sought from the Environment Agency in this regard.** This is likely to include the need to assess breach failure over a 36hour period, considering the impact of rising and falling water levels within the Thames during the tide cycle. Furthermore, whilst a relatively detailed 4m grid has been adopted for SFRA purposes, localised obstructions (including, for example, boundary walls) may not be reflected at all locations. These may influence flood flow routes locally, and may need to be considered in greater detail at FRA stage.

## **APPENDIX D**

# Assessment of Flood Hazard & Rate of Inundation (River Thames)





## **Assessment of Flood Hazard**

An assessment of Flood Hazard has been established across the northern proportion of the Borough, adjoining the River Thames, building upon the findings of the breach modelling carried out above. The flood hazard has been calculated as a product of depth and velocity in accordance with Table E1 below (Defra FD2320).

**Table E1 Hazard to People as a Function of Velocity and Depth<sup>42</sup>**

<b>Depth Velocity Factor D* (V+0.5)</b>	<b>Flood Hazard</b>	<b>Description</b>
< 0.75	Low	Caution
0.75 – 1.25	Moderate	Dangerous for some (children)
1.25 – 2.5	Significant	Dangerous for most people
> 2.5	Extreme	Dangerous for all

To provide a consistent measure of hazard across the north of the Borough for planning purposes, it was necessary to 'merge' the results of the breach modelling along the length of the River Thames frontage, and to establish a sensible and robust assessment of potential flood depth and flow velocity. The breach modelling that underpins this analysis is explained in Appendix E<sup>43</sup>.

To develop a robust scenario for planning purposes, the flood hazard has been calculated at 4hours and 15hours following a breach of the River Thames defences. The maximum of the two (representing the worst case scenario when assessing flood depth vs flow velocity) has then been adopted and reflected in the adjoining Flood Hazard Map.

Throughout the remainder of the Borough, a 'design' water level of 4mAOD and flow velocity of 0.5m/s has been assumed. This is a conservative yet pragmatic assumption, and is based upon the following key arguments:

- A discussion with the Environment Agency has confirmed that the Thames Barrier will be closed immediately following a high tide that results in flooding within the city of London. This would suggest that no more than one tide cycle (6 hours) will inundate the Borough;
- The breach modelling carried out to date indicates that flow will move relatively slowly into the Borough with velocities generally not exceeding 0.2 to 0.5m/s;
- The breach modelling indicates that the maximum flood levels throughout the inundated area some 4 hours after a breach failure of the defences are approximately 4mAOD. After 15hours, the maximum flood level remains at or near this level;

The adopted Flood Hazard Map is provided as Figure D.

<sup>42</sup> Defra/EA - Flood Risks to People, FD 2321/TR1, March 2006.

<sup>43</sup> As explained in Appendix E, a total of 9 breach locations have been modelled for SFRA purposes. Whilst considered unlikely, a potential risk to life may occur as a result of breach failure at other locations along the defence line, and therefore LiDAR has been used to review the 'hazard' immediately behind the defences at these locations (based upon extrapolation of flood depth and flow velocity from the modelled breach hazard envelopes).

### *Debris Factor*

Guidance on the assessment of flood hazard (FD2321) requires the consideration of a debris factor. In simple terms, the Debris Factor (DF) reflects the likelihood of material being carried by the flood wave, resulting in an increase in the risk posed to life and property.

This was considered within the context of the River Thames and the London Borough of Lewisham. Given the conservative nature of the assumptions taken in the breach analysis (see Appendix C), and the relatively shallow nature of the flood wave throughout much of the area, it was considered unnecessary to include a further incremental increase as a result of debris.

### **Assessment of Onset (Time) to Inundation**

To enable an assessment of Flood Risk throughout the Borough for planning purposes, an approximation of the time of inundation (following a breach failure of the River Thames defences) was carried out.

Building upon the results of the breach modelling, zones have been developed that depict areas that will be inundated in less than 6 hours, 6 to 12 hours, and greater than 12 hours respectively. This has simply mapped those areas of the Borough within which flooding has occurred following a breach within the time envelopes stipulated.

The period in which flood flows will take to inundate an area is a key factor when considering risk. Clearly an available flood warning time of greater than 12 hours will enable a large proportion of the general public to take proactive action to reduce the potential damage to property, and to evacuate to markedly reduce the potential risk to life.

The adopted Rate of Inundation Map is provided as Figure C.

## **APPENDIX E**

### Permitted Land Use PPS25 Table D2 (Appendix D)



Essential Infrastructure	<ul style="list-style-type: none"> <li>• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.</li> </ul>
Highly Vulnerable	<ul style="list-style-type: none"> <li>• Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding.</li> <li>• Emergency dispersal points.</li> <li>• Basement dwellings.</li> <li>• Caravans, mobile homes and park homes intended for permanent residential use.</li> <li>• Installations requiring hazardous substances consent.<sup>19</sup></li> </ul>
More Vulnerable	<ul style="list-style-type: none"> <li>• Hospitals.</li> <li>• Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.</li> <li>• Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels.</li> <li>• Non-residential uses for health services, nurseries and educational establishments.</li> <li>• Landfill and sites used for waste management facilities for hazardous waste.<sup>20</sup></li> <li>• Sites used for holiday or short-let caravans and camping, <b>subject to a specific warning and evacuation plan.</b></li> </ul>
Less Vulnerable	<ul style="list-style-type: none"> <li>• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assembly and leisure.</li> <li>• Land and buildings used for agriculture and forestry.</li> <li>• Waste treatment (except landfill and hazardous waste facilities).</li> <li>• Minerals working and processing (except for sand and gravel working).</li> <li>• Water treatment plants.</li> <li>• Sewage treatment plants (if adequate pollution control measures are in place).</li> </ul>
Water-compatible Development	<ul style="list-style-type: none"> <li>• Flood control infrastructure.</li> <li>• Water transmission infrastructure and pumping stations.</li> <li>• Sewage transmission infrastructure and pumping stations.</li> <li>• Sand and gravel workings.</li> <li>• Docks, marinas and wharves.</li> <li>• Navigation facilities.</li> <li>• MOD defence installations.</li> <li>• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.</li> <li>• Water-based recreation (excluding sleeping accommodation).</li> <li>• Lifeguard and coastguard stations.</li> <li>• Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.</li> <li>• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, <b>subject to a specific warning and evacuation plan.</b></li> </ul>

PPS25 Table D2 (Appendix D)  
Flood Risk Vulnerability Classification



## **APPENDIX F**

### **Overview of Flood Risk Character Area Summaries (PPS25 Constraints)**





## Character Area 1 – Deptford and New Cross

### Description of Flood Risk

The majority of this Area is situated within Zone 3a High Probability, affected mainly by tidal flooding from the River Thames, with some land in the east of the area affected by flooding from the River Ravensbourne. A significant proportion of the area is adjacent to the River Thames flood defence line and would be affected if the flood defences fail or are overtopped. This represents a major concern with respect to public safety. A relatively small proportion of the area lies within Zone 2 Medium Probability and Zone 1, Low Probability.

If flooding from the river occurs it is probable that floodwater may lie within the area for an extended period. The River Thames is a very large drainage system, and the speed with which water can drain away is also governed by the operation of the Thames Barrier downstream. This may vary quite considerably, depending upon the nature and the scale of the flooding event, however for planning purposes it should be assumed that the site would be inundated for a period in excess of 24 hours

The River Thames drains a considerable catchment and flooding is typically a result of long duration, regional rainfall events. The Environment Agency endeavours to issue warnings of possible river flooding within this reach, and due to the relatively long catchment response times, lengthy warning of a pending River Thames flood event can generally be provided. The (remote) chance of overtopping of defences from a storm surge tide should be evident several hours beforehand. There is continuous monitoring of tide levels as tides move southward down the East coast from Scotland, and the Environment Agency aims to issue a warning at least 2 hours in advance. This should enable the Council, emergency services, residents and businesses to take actions to minimise property damage and risk to life.

### Planning Recommendations

Of the sites identified in Lewisham's Development Policies and Site Allocations (Preferred Options Report) of March 2007, two are confirmed as being within Flood Zone 3a High Probability. These are: the New Cross Hospital Site, DC03 and the Rival Envelope Company site at Trundleys Road, DC30. Two further sites are confirmed as being in Flood Zone 1 Low Probability: the site at New Cross Station Amersham Vale DC2 and the site between New Cross Gate Station, 267 New Cross Road and 17-25 Goodwood Road DC22.

Several sites:

- Comet Street, DC12,
- Octavius Street and Deptford Station, DC15,
- land to the rear of 161-171 New Cross Road, DC21

have been identified as being sited in Flood Zone 1, rather than in Flood Zone 3 as suggested in the Preferred Options Report.

Other sites are located in areas of lower flood risk than originally considered.

These are: the former Alfred Morris day centre site, Clyde Street, DC11, which is located in Flood Zone 2, Medium Probability, and not Flood Zone 3 High Probability;

Giffin Street, DC13, which is partly in Flood Zone 1 Low Probability and partly in Flood Zone 2 Medium Probability not Flood Zone 3;

Kender Estate New Cross Gate DC23 is mainly in Flood Zone 1 Low Probability with some areas on site in Flood Zones 2 Medium Probability and Flood Zone 3a High Probability, not all Flood Zone 3.

More detailed flood risk assessments will be needed to test the emerging proposals for all the sites in Flood Zones 3a and 2.

The North Lewisham Master plan, a document produced for Lewisham to provide a spatial strategy for 'connections, places and selected mixed use sites' includes proposals for six further sites:

Arklow Road,	DCE 12
Oxestalls Road	DCE 13
Plough Way	DCE 14
Surrey Canal Road	DCE 15
Grinstead Road	DCE 16
Sun and Kent Wharves	DCE 18

All these sites, lying in Flood Zone 3a, High Probability are proposed to become mixed use, that is with an element of residential use. On some sites such as Surrey Canal Road, home of Millwall Football Club, this would be a substantial element. The change in proposed use from employment alone to mixed use including residential will mean that these sites incorporate more vulnerable uses than employment alone, which will need to be taken into account when detailed proposals for redevelopment are being considered.

## **Character Area 2 – Ladywell**

### **Description of Flood Risk**

Nearly all the land in this Character Area lies in Flood Zone 1 Low Probability. The River Ravensbourne runs along the eastern boundary and where there is an associated flood risk this is confined to the area immediately adjacent to the river as shown in the Flood Risk Map 2.

### **Planning Proposals**

Of the sites identified in Lewisham's Development Policies and Site Allocations (Preferred Options Report) of March 2007 which are located in the Ladywell Character Area, the sites at Brockley Station, Coulgate Street, Mantle Road, St Norberts Road, Brockley Cross and Endwell Road DC8, land rear of the Christian Fellowship Centre, DC20 (not shown on the Flood Zone map 2) and Tanners Hill DC27 are confirmed as Flood Zone 1.

The western part of the site at the Seager Buildings, Brookmill Road, DC9 has been identified as being in Flood Zone 2 Medium Probability, not Flood Zone 3a High Probability. The area of land immediately adjacent to the river, which is defended at that point, remains in Flood Zone 3a High Probability. A more detailed flood risk assessment will be needed to test the emerging proposals for this site.

The Somerville Adventure Playground, DC24, has been identified as being in Flood Zone 1 Low Probability, not Flood Zone 3 as set out in the Preferred Options Report.

## **Character Area 3 – Blackheath**

### **Description of Flood Risk**

Parts of this Character Area, particularly in the north, are formed of high ground and not at risk of flood. However the Quaggy River and its branches in the southern area and at the western boundary of the Blackheath Character Area are associated with fairly extensive areas of Flood Zone 3a High Probability, fringed in places by small areas of Flood Zone 2 Medium Probability, and some open areas of land remaining as Functional Flood Plain Flood Zone 3b. Small sections of the Quaggy River in this area are defended, but the Flood Zone 3a designation covers a large number of residential properties and includes several schools and an ambulance station on Lee High Road.

### **Planning Proposals**

There is only one site within Blackheath Character Area included in the Preferred Options Report as a proposal: 9 Staplehurst Road and rear of Leahurst Road, Hither Green DC26. Adjacent to the railway and previously thought to be in Flood Zone 1 Low Probability, about half the site - the northern and eastern parts lying closest to the River Quaggy - is affected by Flood Zone 3a High Probability and a small area is in Flood Zone 2 Medium Probability.

More detailed flood risk assessments will be needed to test the emerging proposals for the site.

## **Character Area 4 – Lewisham Town Centre**

### **Description of Flood Risk**

The Rivers Ravensbourne and Quaggy both cross this character area and indeed join near the northern end, (before outfalling in Deptford Creek). Both are associated with areas of Flood Zone 3a, High Probability. The Flood Zone includes the whole of Lewisham Centre and parts of Lewisham Hospital and the Police station, both of which are to the south on Lewisham High Street as well as several schools and residential areas. South of Ladywell Bridge Station there is an area of Functional Flood Plain between the railway and the river, behind the hospital. For the most part the rivers are undefended as they run through the area. However north of the confluence of the Ravensbourne and the Quaggy, to the north of Station Road, there is a defence along the western/southern edge.

### **Planning Proposals**

Only one of the sites in the Preferred Options report is located within the Lewisham Town Centre Character Area: sites at Nightingale Grove, Hither Green DC25. This proposal is confirmed as being within Flood Zone 1 Low Probability. All the other proposal sites are included in the Area Action Plan for the Town Centre, and most of these are affected by Flood Zones 3a and 2. Many of the sites, described in the Area Action Plan Preferred Options Report as Lewisham Gateway, Lewisham Town Centre and Lee High Road, plus several sites within the Loampit Vale area, are entirely within Flood Zone 3a, High Probability: LAAP 01, 02, 03, 04, 08, 12 and 15, with some small areas of Flood Zone 2 Medium Probability. Sites LAAP 09, 10 and 11 (Loampit Vale) are partly within Flood Zone 2 Medium Probability.

It should be noted that site LAAP 06, the Hartwell Ford site, is mainly Flood Zone 3b Functional Flood Plain from the River Quaggy which flows to the south west of the site, and is undefended. As such the site could flood regularly and the redevelopment potential should be considered carefully.

More detailed flood risk assessments will be needed to test the emerging proposals for these sites.

Three sites, LAAP 07, 13 and 14 (these two are grouped as Conington Road) are within Flood Zone 1 Low Probability.

## **Character Area 5 – Catford Town Centre**

### **Description of Flood Risk**

The flood risk zone in this area lies along the Ravensbourne as it runs north to join the Quaggy at Lewisham and comprises Flood Zone 3a and 2. Some of these areas close to the river, which at this point is undefended, remain as open land, such as Ladywell Fields and the sports ground to the south of Catford Bridge Station. The former Greyhound Stadium and the Ladywell Arena to the north are both sports venues within Flood Zone 3a High Probability. However some existing residential areas are affected by Flood Zones 3a High Probability and 2 Medium Probability, as are parts of Catford Town Centre which also lies close to the river.

### **Planning Proposals**

There are five key sites in the Catford Area Action Plan: CAAP 01 the Catford Shopping Centre and Milford Towers. The eastern part of this site is in Flood Zone 1 but the southern third is in Flood Zone 3a High Probability and the NW area is in Flood Zone 2 Medium Probability. The second site, CAAP 02, Civic Quarter, is also affected as the western half is in Flood Zone 3a High Probability with a narrow fringe adjacent lying in Flood Zone 2 Medium Probability. Site three, CAAP 03, the Plassy Road area, is entirely in Flood Zone 1 Low Probability. CAAP 4, the Greyhound Stadium Area, lies close to the Ravensbourne which is unprotected along this stretch. It is entirely in Flood Zone 3a High Probability apart from the NW tip and a small area of Flood Zone 3b Functional Flood Plain to the south of the site adjacent to Old Ford Hill. The final site, the Wickes site CAAP 05, is crossed by the river. There are areas of Flood Zone 3a to the east of the river, Flood zone 2 Medium Probability to the west, and Flood Zone 1 Low Probability in the south. More detailed flood risk assessments will be needed to test the emerging proposals for all these sites.

## **Character Area 6 – Perry Vale**

### **Description of Flood Risk**

This Character Area includes relatively high ground, and is for the most part well away from the Pool River and the associated Flood Zones. The areas where there is land within Flood Zone 3a are mainly undeveloped and in use as allotments, sports and cricket grounds. However there are some residential properties lying within Flood Zone 3a: houses at the southern end of Riverview Park off Old Ford Hill south of Catford, where land (mainly gardens) lies within Flood Zone 3a High Probability, and also properties on Pool Court and Fordmill Road close to the confluence of the Pool River and the Ravensbourne.

Further south, near the borough boundary, there is some further land within Flood Zone 2 Medium Probability which includes residential properties along Worsley Bridge Road and Meadowview Road and the western half of Southend Park to the east of the railway, but which stretches across to Southend Lane and Stanton Way to the west.

### **Planning Proposals**

There are several sites in the Preferred Options report: DC17, sites at Forest Hill, DC20, O'Rourke Transport/Sivyer Transport site, DC28 154-160 Sydenham Road, and DC29 113-157 Sydenham Road, which are all located in Flood Zone 1 Low Probability. The last site, Bell Green Gas works, previously thought to be entirely in Flood Zone 1, Low Probability, is adjacent to the Pool River and a small area in the north east of the site is included in Flood Zone 2, Medium Probability, with small associated areas of Flood Zone 3a High Probability. There are no firm proposals for redevelopment at this stage, but a more detailed assessment should form part of the preparation of a detailed scheme in due course.

## **Character Area 7 – Downham**

### **Description of Flood Risk**

The Downham Character Area is, like Perry Vale, on mainly higher ground. There are two areas, in the west where the Ravensbourne runs north before it joins the Pool River, and a section of the Quaggy which crosses the eastern section of the area. Small stretches in each river are defended, but most of the length of each appears to be unprotected.

There are areas of open land alongside the Ravensbourne which fulfil the function of Flood Zone 3b Functional Flood Plain, particularly on the sports fields north east of Beckenham Place Park. However there is a substantial area of residential development, bounded by the Bromley Road which is Flood Zone 3a High Probability. Areas continuing northwards on both banks lie in Flood Zones 3a High Probability and Flood Zone 2 Medium Probability.

### **Planning Recommendations**

There is only one proposal for a site in the Downham Character Area in the Preferred Options report, DC09, the former United Dairies site in Baring Road. As stated in the report, the site is in Flood Zone 1 Low Probability.

Any development proposals coming forward in the areas adjacent to the Ravensbourne in the west of the area need to be carefully considered for the implications for changing the flood regime in the area.