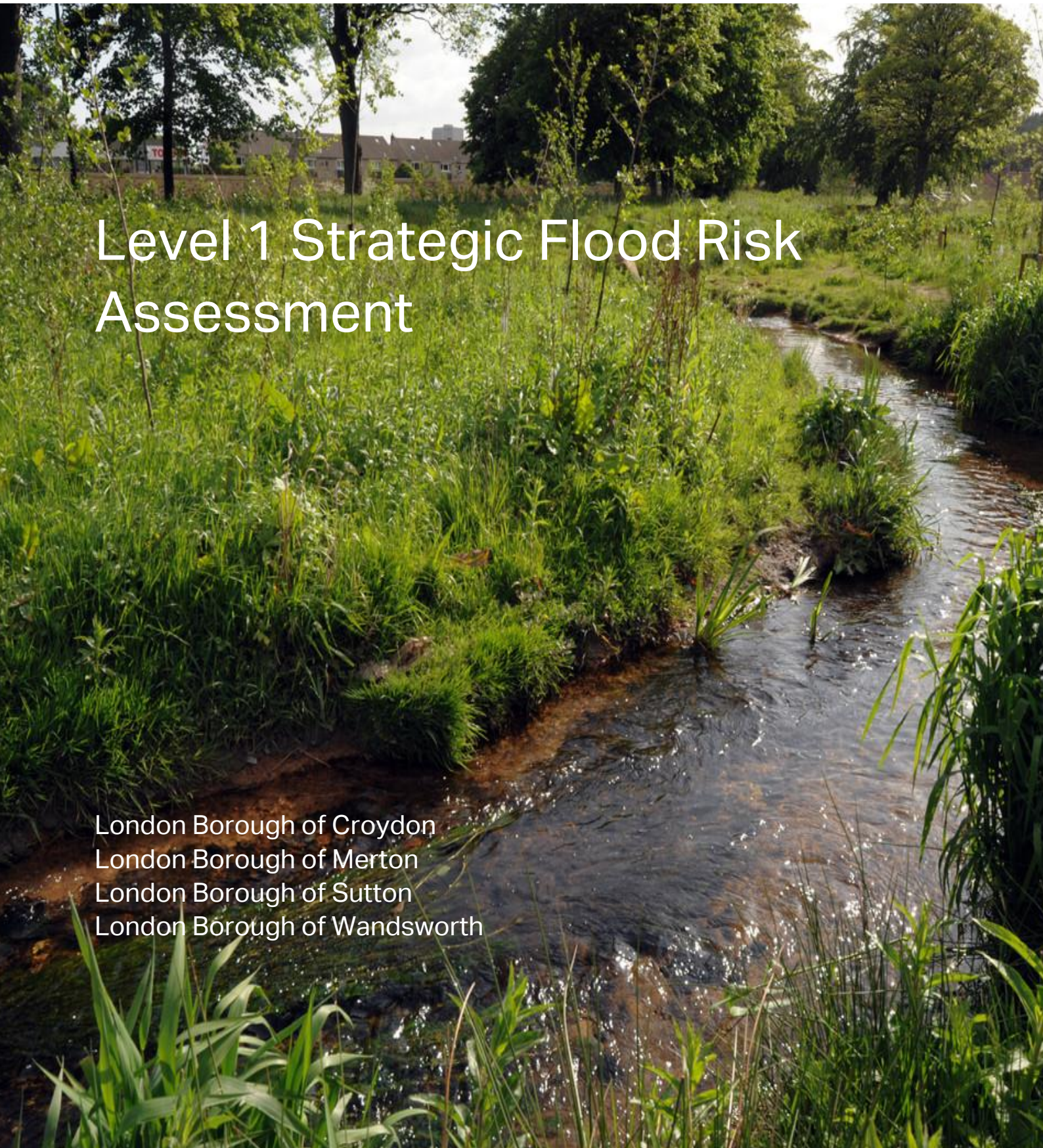
Final Report

Submitted to
London Boroughs of Croydon,
Merton, Sutton and Wandsworth

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Level 1 Strategic Flood Risk Assessment

London Borough of Croydon
London Borough of Merton
London Borough of Sutton
London Borough of Wandsworth

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2	2nd Draft report for client and stakeholder comment	Sarah Littlewood	Elizabeth Gent	10/11/2015
3	Final version	Elizabeth Gent	Elizabeth Gent	17/12/2015

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December 2015

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List of Acronyms

ABD	Areas Benefiting from Defences
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
AIMS	Asset Information Management System
BGS	British Geological Survey
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
DC	Drainage Catchment
Defra	Department for Environment, Flood and Rural Affairs
DRN	Detailed River Network
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FWMA	Flood and Water Management Act 2010
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum
NPPF	National Planning Policy Framework
RBD	River Basin District
PPG	Planning Policy Guidance
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TTD	Thames Tidal Defences
TWUL	Thames Water Utilities Ltd
uFMfSW	Updated Flood Map for Surface Water

Glossary of Terms

Glossary	Definition
Annual exceedance probability (AEP)	Chance of occurrence in any one year, expressed as a percentage. For example, a 1% annual probability event has a 1 in 100 chance of occurring in any given year.
Areas Benefitting from Defences (ABD)	Hatched areas on the Environment Agency Flood Map for Planning (Rivers and Sea) behind flood defences, which, if the flood defences were not present, would flood, in the event of a river flood with a 1 per cent (1 in 100) chance of happening each year, or a flood from the sea with a 0.5 per cent (1 in 200) chance of happening each year.
Asset Information Management System (AIMS)	Environment Agency management system of assets associated with main rivers including defences, structures and channel types. Information regarding location, standard of service, dimensions and condition.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan (CFMP)	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances, including flooding.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions. For fluvial events a 20% increase in river flow is applied and for rainfall events, a 30% increase. These climate change values are based upon information within the NPPF and Planning Practice Guidance (PPG).
Critical Drainage Area (CDA)	The Environment Agency refers to a Critical Drainage Area (CDA) as an area within Flood Zone 1 which has 'critical drainage issues'. Within the SWMPs for each of the London Boroughs, CDAs were delineated based on the following 'working definition': 'a discrete geographic area (usually within an urban setting) where there may be multiple and interlinked sources of flood risk and where severe weather is known to cause flooding of the area thereby affecting people, property or local infrastructure'.
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Drainage Catchment	Generated as part of the Level 1 SFRA, these are based on the natural catchments and watersheds provided within the Flood Estimation Handbook CD-ROM which have then been amended using local knowledge to account for significant infrastructure within the study area that could impact on drainage such as railway lines.
Exception Test	A method set out in the NPPF to help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. The two parts to the Test require proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.
Flood and Water Management Act (FWMA)	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 Floods; the aim of which is to clarify the legislative framework for managing local flood risk (flooding from surface water, groundwater and ordinary watercourses) in England.
Flood Defence	Infrastructure used to protect an area against flooding such as floodwalls and embankments.
Resilience measures	Measures designed to reduce the impact of water that enters property and businesses and to promote fast drying and easy cleaning; for example raising electrical appliances, installing tiled flooring.
Resistance measures	Measures to prevent flood water entering a building or damaging its fabric, for example the use of flood guards. This has the same meaning as flood proofing.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Risk	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece

Regulations	of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood Zone	Areas defined by the probability of river and sea flooding, ignoring the presence of defences. Flood Zones are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea), available on the Environment Agency's web site.
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).
Freeboard	The height of a flood defence crest level (or building level) above a particular design flood level.
Functional Floodplain	Land where water has to flow or be stored in times of flood. It is defined by LPAs within SFRAs. Functional floodplain (also referred to as Flood Zone 3b) is not separately distinguished from Zone 3a on the Environment Agency Flood Map for Planning.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area. Each of the London Boroughs is a LLFA for their respective areas.
Local Planning Authority (LPA)	Body that is responsible for controlling planning and development through the planning system.
Main river	Watercourse defined on a 'main river map' designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for main rivers. However overall responsibility for maintenance lies with the riparian owner.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
National Planning Policy Framework (NPPF)	The National Planning Policy Framework was published on 27 March 2012. It is a framework which sets out the Government's planning policies for England and how these are expected to be applied.
Ordinary watercourse	A watercourse that does not form part of a main river. This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	An approach to future site planning whereby new development is directed towards areas with the lowest probability of flooding before consideration of higher risk areas. The Sequential Test helps ensure that development can be safely and sustainably delivered and developers do not waste their time promoting proposals which are inappropriate on flood risk grounds.
Sewer Flooding	Flooding caused by a blockage or overflowing of a sewer or urban drainage system.
Surface Water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
Surface Water Management Plan (SWMP)	A plan which outlines the preferred surface water management strategy in a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.
Sustainable drainage systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Topographic survey	A survey of ground levels.

Executive Summary

As Local Planning Authorities (LPAs) for their respective administrative areas, the London Boroughs of Croydon, Merton, Sutton and Wandsworth have responsibility for the planning of future development across a large part of central and south west London. One of the key considerations for delivering sustainable development is the early consideration of the risk of flooding (both now and in the future) in the plan-making process, and seeking where possible to steer new development away from areas of high flood risk. This approach is called the sequential approach and is set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance for Flood Risk and Coastal Change (PPG).

This Report provides a Level 1 Strategic Flood Risk Assessment (SFRA) for the four London Boroughs of Croydon, Merton, Sutton and Wandsworth. The purpose of this document is to collate and analyse the most up to date and readily available flood risk information for the study area for all sources of flooding including tidal flooding, flooding from rivers, surface water, groundwater, sewers and reservoirs and artificial sources. As part of this study, data has been requested from other risk management authorities (RMAs) and partner organisations including the London Boroughs of Croydon, Merton, Sutton and Wandsworth, the Environment Agency, Thames Water Utilities Ltd (TWUL), Network Rail, Transport for London (TfL), South East Rivers Trust and Sutton and East Surrey Water.

This data has been gathered and presented in flood maps to provide the LPAs with an overview of flood risk issues across the study area.

The chief sources of fluvial flood risk in the study area are the River Wandle, Beverley Brook, River Graveney, River Ravensbourne and Pyl Brook. Flood mapping identifies relatively narrow floodplains associated with each of these main rivers. Smaller watercourses are present within the study area, and these are typically culverted for large sections beneath highly urbanised areas.

The River Thames forms the northern boundary of the London Borough of Wandsworth, and therefore the northern part of the Borough, including Wandsworth town, are identified to be at risk of tidal flooding from the River Thames. Due to the presence of tidal flood defences the risk is a residual risk, in the event of overtopping or breach in local flood defences. The results of a breach modelling study undertaken for the Environment Agency have been used to map tidal flood hazard for the London Borough of Wandsworth.

Updated national surface water flood risk mapping released by the Environment Agency (the updated Flood Map for Surface Water (uFMfSW)) coupled with a review of the Surface Water Management Plans (SWMPs) for each of the Boroughs has been used to identify areas at risk from surface water flooding. Drainage catchments (DCs) have been identified for each LPA administrative area and mapped with the uFMfSW . In addition, BGS Susceptibility to Groundwater Flooding mapping has been used to provide an understanding of areas where the underlying geology may enable the presence of groundwater below or at the surface level.

The strategic assessment of flood risk provided by this Level 1 SFRA should be used by each Council to apply the Sequential Test to potential future site allocations, to ensure that sites at lowest risk of flooding are developed in preference to those at greater risk of flooding. It can also be used to apply the Sequential Test to individual planning applications located within flood risk areas on unallocated sites which have not previously been subject to the Sequential Test.

The Level 1 SFRA also provides guidance for developers, Development Management Officers, residents and businesses regarding requirements for managing and mitigating flood risk, preparing site-specific FRAs, as well as requirements and recommendations for surface water management measures for potential future development sites. Recommendations are also presented for consideration by each Council during the preparation of their Local Plan policies.

Given the urbanised nature of the study area it is unlikely that it will be possible to accommodate all necessary development outside of those areas identified to be at risk of flooding. As a result, it will likely be necessary to increase the scope of the assessment to a Level 2 SFRA. Independent Level 2 SFRA Reports will be prepared for each LPA to provide more detail on the nature of flooding in key areas and provide the information necessary for the application of the Exception Test for specific development sites where appropriate in accordance with the NPPF.

1 Introduction

1.1 Terms of Reference

AECOM has been commissioned by London Borough of Croydon, on behalf of London Borough of Croydon, London Borough of Merton, London Borough of Sutton and London Borough of Wandsworth Councils to review and revise their joint Level 1 and Level 2 Strategic Flood Risk Assessment (SFRA) for the administrative area covered by the four boroughs.

1.2 Project Background

The National Planning Policy Framework[1] (NPPF) and associated Planning Practice Guidance for Flood Risk and Coastal Change (PPG)[2] emphasise the active role Local Planning Authorities (LPAs) should take to ensure that flood risk is understood and managed effectively and sustainably throughout all stages of the planning process.

The NPPF outlines that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and LPAs should use the findings to inform strategic land use planning. Figure 1-1 overleaf, reproduced from the PPG, illustrates how flood risk should be taken into account in the preparation of the Local Plans for each of the four boroughs.

The original Level 1 SFRA for the London Boroughs of Croydon, Merton, Sutton and Wandsworth was produced by Scott Wilson in 2008[3]. Since this release, there have been a number of changes in legislation and guidance relating to planning and flood risk. The introduction of the Localism Act in 2011 was intended to create a planning system oriented around consideration of local planning issues. Planning Policy Statements (PPS), covering all aspects of national planning policy have since been replaced by the NPPF. The accompanying technical guidance document relating to flood risk, originally derived from the PPS documents has also been recently replaced by the Planning Practice Guidance (PPG).

The Flood and Water Management Act (FWMA) attained royal assent in 2010, with the intention of enabling the provision of more effective flood management following the flooding of July 2007. As such, each of the London Boroughs is designated a Lead Local Flood Authority (LLFA) and have significant duties and powers in relation to flooding from local sources, specifically surface water, groundwater and ordinary watercourses. The Environment Agency retains responsibility for leading and coordinating the management of flood risk associated with main rivers and the sea.

As well as legislative and planning policy changes, a number of new and revised datasets have been made available since the release of the original Level 1 SFRA. Environment Agency flood risk mapping has been revised for the River Wandle catchment as well as breach assessments along the River Thames frontage; updated national surface water flood risk mapping has been released by the Environment Agency for use by LPAs in SFRAs; and broad scale mapping of susceptibility to groundwater flooding has been purchased by the Councils from the British Geological Survey (BGS).

The purpose of the revised Level 1 SFRA is to collate and analyse the most up to date readily available flood risk information for all sources of flooding, to provide an overview of flood risk issues across the study area. This will be used by each Council to inform the preparation of Local Plans, including the application of the Sequential Test to future site allocations. It is also intended that the revised Level 1 and 2 SFRA deliverables will assist prudent decision-making on flood risk issues by Development Management Officers on a day-to-day basis.

[1] Department for Communities and Local Government. 2012. *National Planning Policy Framework*. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2

[2] Department for Communities and Local Government. 2014. *Planning Practice Guidance: Flood Risk and Coastal Change.* Available at: http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

[3] Scott Wilson, December 2008, Level 1 Strategic Flood Risk Assessment for London Boroughs of Wandsworth, Merton, Sutton and Croydon, Final Report

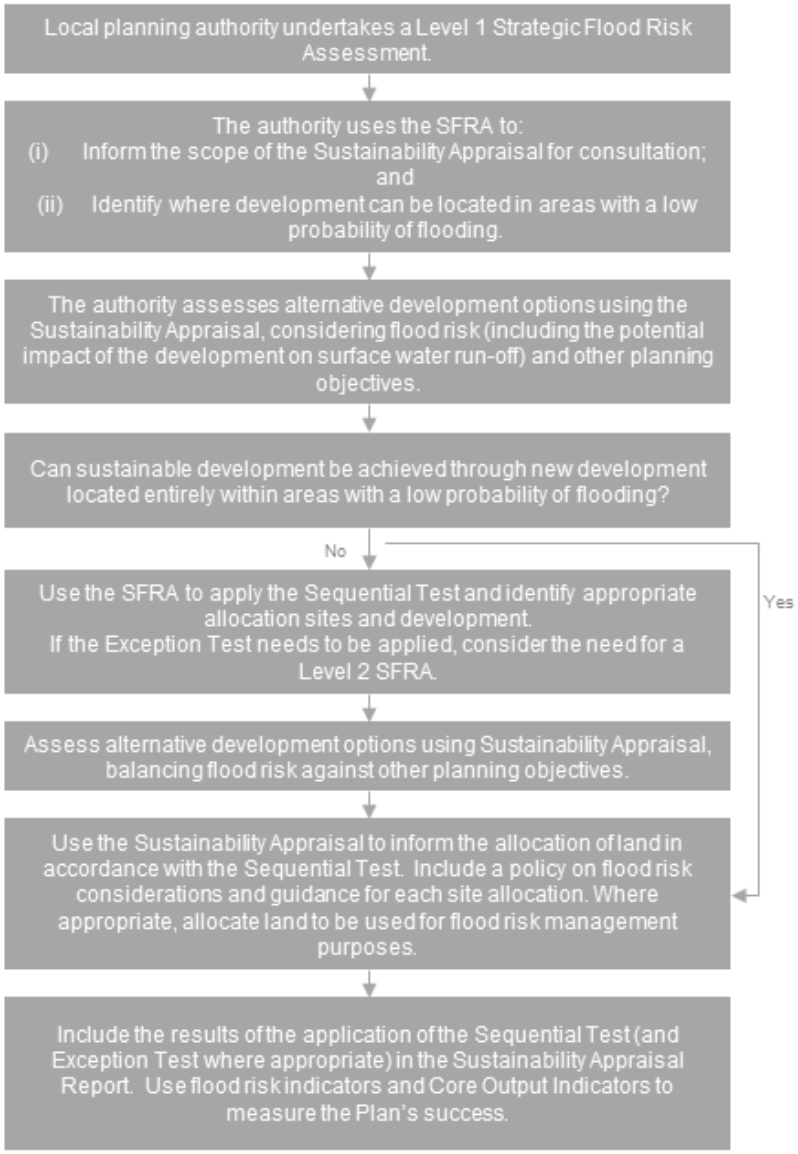


Figure 1-1 Taking flood risk into account in the preparation of a Local Plan (PPG, p6)

1.3 Level 1 SFRA Deliverables

It is anticipated that the SFRA will have a number of end users, with slightly different requirements. This Section describes how to use the SFRA and how to navigate the report and mapping deliverables. One combined Level 1 SFRA report has been prepared for the four Boroughs and is structured as follows:

- Section 1: Study Area Description and Partner Organisations
- Section 2: Legislative and Planning Policy Context
- Section 3: Level 1 Methodology and Datasets
- Section 4: Flood Risk in **Croydon**
- Section 5: Flood Risk in **Merton**
- Section 6 Flood Risk in **Sutton**
- Section 7: Flood Risk in **Wandsworth**
- Section 8: Guidance on the Application of the Sequential Test
- Section 9: Guidance for Managing and Mitigating Flood Risk
- Section 10: Guidance for the Application of SuDS
- Section 11: Guidance for preparing Site Specific FRAs

- Section 12: Flood Risk Policy and Development Management Considerations
- Section 13: Next Steps
- Appendix A: Figures
- Appendix B: Sustainability Appraisal Objectives

Sections 4 – 7 provide a strategic assessment of flood risk from all sources across the four boroughs. The suite of figures included within Appendix A should be referred to when reading these Sections.

Section 8 provides guidance on the application of the Sequential Test by each LPA when allocating future development sites as part of the plan-making process, as well as by developers promoting development on windfall sites. The strategic assessment of flood risk presented in Sections 4-7 will inform the completion of the Sequential Test.

Section 9-11 present guidance for managing and mitigating flood risk, the application of sustainable drainage systems (SuDS), and the preparation of site specific Flood Risk Assessments (FRAs).

Section 12 outlines a number of flood risk management objectives and policy considerations which may be developed and adopted by the London Boroughs as formal policies within their developing Local Plans.

1.4 Study Area

The study area, as shown in **Appendix A Figure 1**, is defined by the administrative boundaries of the London Boroughs of Croydon, Merton, Sutton and Wandsworth. These boroughs form a large part of south and south west London, bordered to the north by the River Thames, to the east by London Boroughs of Lambeth, Southwark and Bromley, to the south by Surrey County and to the west by Royal Borough of Kingston upon Thames and London Borough of Richmond upon Thames.

The northern part of the study area is heavily developed, with interspersed open areas such as Battersea Park, Wimbledon Common, Tooting Bec Common, Clapham Common and Mitcham Common. The scale and density of development generally reduces with distance from central London, and there are greater areas of undeveloped land in the southern parts of Sutton and Croydon, towards the border with Surrey.

1.4.1 Topography

The northern edge of the study area comprises low lying land adjacent to the course of the River Thames and the floodplain of the River Wandle. Either side of the River Wandle, there are higher areas including Clapham Common located at approximately 22mAOD (metres Above Ordnance Datum), and Putney Heath and Wimbledon Common, where elevations reach approximately 55mAOD.

The rest of London Borough of Merton is lower lying at 20-35mAOD, with gentle slopes associated with the floodplains of the River Wandle and Beverley Brook. Ground levels increase gradually through the northern part of London Boroughs of Sutton and Croydon, reaching 79mAOD in Belmont, and 54mAOD in South Norwood Country Park.

Further south, elevations increase more noticeably, reaching 129mAOD in New Addington and 175mAOD in Old Coulsdon. This part of the study area is characterised by much steeper slopes, and well defined valleys, which is evident when viewing the mapping of surface water flood risk presented in **Appendix A Figure 2.2, Figure 3.2, Figure 4.2 and Figure 5.2.**

1.4.2 Hydrogeology

The Solid Geology across the study area consists of Chalk at the southern extent, which gives rise to the Lambeth Group and London Clay to the north. The Drift deposit geology is dominated by River Terrace Deposits, with Alluvium also present along the Wandle valley and Clay with flints present along the southern boundary of London Borough of Croydon.

Due to the dominance of Chalk throughout the south of the study area, across the southern parts of London Boroughs of Croydon and Sutton, extensive aquifers are found here with many used for potable and/or industrial water supply. In addition most of the watercourses in the area are spring-fed, indicating groundwater levels are at or very close to the ground surface in some locations.

1.4.3 Principal Watercourses

There are a number of designated main rivers in the study area, the approximate locations of which are shown in **Appendix A Figure 1.** Main rivers are watercourses shown on the statutory main river maps held by the Environment Agency and the Department for Environment, Flood and Rural Affairs (Defra). The Environment Agency has permissive powers to carry out works necessary for flood defence purposes on these rivers. The overall responsibility for maintenance however, lies with the riparian owner.

- The **River Wandle** catchment, which includes the River Graveney tributary, drains a total area of approximately 200km2. The Wandle flows from south to north through all four of the London Boroughs in the study area and discharges into the Thames at Bell Lane Creek in Wandsworth. The southern half of the catchment is underlain by Chalk which is highly permeable, allowing surface water to infiltrate into the ground rather than runoff into the Wandle. The northern half of the catchment is underlain by London Clay with very limited permeability which can generate significant volumes of rapid surface water runoff during periods of heavy rainfall. Overall however, the Wandle catchment is heavily urbanised and therefore generally responds rapidly to rainfall. The two sources of the Wandle are springs at Carshalton and Waddon, which rise at the junction between the Chalk and the overlying Clays and Gravels. The Carshalton and Waddon branches combine at Hackbridge then flow through Mitcham, where a short tributary called the Beddington Corner branch also joins the main channel. This branch carries discharge from Beddington Sewage Treatment Works (BSTW). Bunces Ditch and the Pickle are tributaries of the River Wandle within the London Borough of Merton.

- The **River Graveney** joins the Wandle at Summertown. The source of the River Graveney is located in the vicinity of Selhurst and the upper reaches are often referred to as the Norbury Brook. The River Graveney forms the boundary between London Borough of Croydon and London Borough of Lambeth and the boundary between London Borough of Merton and London Borough of Wandsworth along parts of its course. Figgs Marsh Ditch is a tributary of the River Graveney within the London Borough of Merton.

- The **Beverley Brook** catchment, which includes the Pyl Brook tributary, drains a total area of approximately 65km^2 and discharges into the Thames at Barn Elms, upstream of Putney. Flood relief culverts are located in the lower catchment, which discharge into the Thames at Barnes Bridge. The Beverley Brook rises in Cuddington Recreation Ground in Worcester Park and flows north through Motspur Park along the western boundary of the Borough of Sutton and Merton. The Beverley Brook continues to flow north along the western boundary of the Borough of Merton incorporating Wimbledon Common. In the lower reaches the Brook flows through Richmond Park, within the Borough of Richmond upon Thames, before turning northwest and flowing along the western boundary of the Borough of Wandsworth.

- The **Pyl Brook** rises in Sutton, at the junction between the Chalk and the overlying Clays. The Brook and its tributary, the East Pyl Brook, flows north east through Sutton and Merton to the confluence with the Beverley Brook at Raynes Park.

- The **River Thames** defines the northern boundary of the London Borough of Wandsworth. The River Thames drains an extensive catchment (16,000km^2), stretching from the Cotswolds in Gloucestershire, through Oxfordshire, Buckinghamshire and west London and from this point passing eastwards through central London to discharge into the Thames Estuary near Southend-on-Sea. The tidal limit of the Thames is situated at Teddington Weir approximately 20km upstream of Wandsworth Bridge. This section of the River Thames benefits from an extensive network of flood defences that protects London to a 1 in 1000 year standard of protection. The Thames Barrier, located in Woolwich Reach lies approximately 25km downstream of the study area and is the main structure of the Thames Tidal Defence system. Further details regarding flood defences are included in Section 3.2.6.

- A small area of the **River Ravensbourne** catchment flows through the north east of London Borough of Croydon before entering the London Borough of Bromley, which is outside of the study area. The wider River Ravensbourne catchment drains approximately 180km^2 of south east London and discharges into the Thames at Deptford Creek. The catchment extends from the North Downs where ground levels are approximately 270m above sea level and as such the Ravensbourne and tributaries typically have relatively steep bed gradients. The natural river channel has also been replaced with concrete lined channel throughout urban areas therefore the combined effect of the steep gradient and urbanisation is that the catchment responds very rapidly to rainfall events. The St James Stream, Chaffinch Brook and Pool River are tributaries of the River Ravensbourne which flow through the north east of London Borough of Croydon. The total length of channel within the study area is approximately 3km, which consists of mixture of natural and urban channel. Due to the nature of the catchment and its rapid response to rainfall, flooding problems tend to be more severe in the lower reaches of the system, with less impact typically felt in these upper reaches within the study area.

1.5 Partner Organisations

There are several organisations involved in development and flood risk management across the study area. These are identified below.

London Boroughs of Croydon, Merton, Sutton and Wandsworth are the Local Planning Authorities (LPAs) for the study area, responsible for long term strategic planning of future development through the preparation of Local Plans, as well as for determining planning applications within each Borough. Under the Flood and Water Management Act (FWMA) these four Councils are also Lead Local Flood Authorities (LLFA) for the respective administrative areas, and have a duty to take the lead on the management of local flood risk, which includes flood risk from surface water, groundwater and ordinary watercourses. From 6th April 2015, Sustainable Drainage Systems (SuDS) are required for all major developments[4], where appropriate, in the London Boroughs of Croydon, Merton, Sutton and Wandsworth and through the use of planning conditions or planning obligations, clear arrangements are required to be in place for the ongoing maintenance of SuDS over the lifetime of the development.

The Environment Agency has a strategic overview role for flood risk management associated with main rivers in south west London (River Thames, River Ravensbourne, River Wandle, River Graveney, Beverley Brook and Pyl Brook) and is a statutory consultee for any development proposed within Flood Zone 2 and 3 associated with these watercourses. The Environment Agency is continually improving and updating their flood map for main rivers and has permissive powers to carry out flood defence works, maintenance and operational activities for these main rivers. However, overall responsibility for maintenance lies with the riparian owner.

Thames Water Utilities Ltd (TWUL) has a duty as a statutory water undertaker to provide clean and waste water services to the study area and is responsible for the management, maintenance and operation of flood control structures under their ownership. Water Companies are defined as a Risk Management Authority within the FWMA and are responsible for flood risk management functions in accordance with the Water Resources Act 1991 and the Land Drainage Act 1991. TWUL is responsible for surface water drainage from development via adopted sewers and for maintaining trunk sewers into which many of the highway drainage in the study area connects.

Sutton and East Surrey Water has a duty as a statutory body to provide clean water services to the southern part of the study area.

Network Rail operates the railway lines and associated infrastructure (signalling, bridges, embankments and tunnels) across the study area. Network Rail is an important stakeholder with regards to flood risk management, through ensuring Network Rail assets are protected from flooding, and that the operation and maintenance of railway assets and infrastructure does not increase the flood risk to neighbouring areas. Network Rail embankments, cuttings and drainage infrastructure have a significant impact on surface water drainage and flood risk in each borough.

Transport for London (TfL) has a responsibility under the Highways Act 1980 for the effectual drainage of surface water from adopted roads and along major roads (red routes) insofar as ensuring that drains, including kerbs, road gullies and ditches and the pipe network which connect to the sewers, are maintained.

South East Rivers Trust (SERT) is an environmental charity dedicated to the conservation and restoration of rivers in south east England. Expanded from the Wandle Trust, the SERT seeks to achieve Good Ecological Status or Potential, and the management of their catchments to set international standards for urban and rural community-driven sustainability and environmental excellence in river rehabilitation and restoration. As such, the SERT are involved in the understanding of flood risk in the local area as well as the implementation of management and mitigation measures.

[4] Developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010)

2 Legislative and Planning Policy Context

2.1 Introduction

This Section provides an overview of the legislative and national and local planning policy context for each of the LPAs with respect to flood risk. The information presented in the SFRA should be used by the Boroughs to establish robust policies in relation to flood risk as part of their emerging Local Plans.

2.2 Flood and Water Management Act

In response to the severe flooding across large parts of England and Wales in summer 2007, the Government commissioned Sir Michael Pitt to undertake a review of flood risk management. The Pitt Review – Learning Lessons from the 2007 Floods[5] and subsequent progress reviews outlined the need for changes in the way the UK is adapting to the increased risk of flooding and the role different organisations have to deliver this function.

The Flood and Water Management Act 2010 (FWMA)[6], enacted by Government in response to The Pitt Review, designated unitary authorities, such as the London Boroughs, as Lead Local Flood Authority (LLFA). As LLFAs, each London Borough has responsibilities to lead and co-ordinate local flood risk management. Local flood risk is defined as the risk of flooding from surface water runoff, groundwater and small ditches and watercourses (collectively known as ordinary watercourses).

The FWMA also formalises the flood risk management roles and responsibilities for other organisations including the Environment Agency, water companies and highways authorities. The responsibility to lead and co-ordinate the management of tidal and fluvial flood risk remains that of the Environment Agency.

2.2.1 National Strategy for Flood and Coastal Erosion Risk Management

In accordance with the FWMA, the Environment Agency has developed a National Strategy for Flood and Coastal Erosion Risk Management (FCERM) in England[7]. This Strategy provides a framework for the work of all flood and coastal erosion risk management authorities.

The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It sets the context for, and informs the production of local flood risk management strategies by LLFAs, which will in turn provide the framework to deliver local improvements needed to help communities manage local flood risk. It also aims to encourage more effective risk management by enabling people, communities, business and the public sector to work together to:

- ensure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively;
- set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risks;
- encourage innovative management of risks taking account of the needs of communities and the environment;
- ensure that emergency responses to flood incidents are effective and that communities are able to respond properly to flood warnings; and,
- ensure informed decisions are made on land use planning.

The Environment Agency's 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities'[8] guidance is a supporting note for the National FCERM Strategy. It provides the UK Climate Projections (UKCP09) climate change factors for river flood flows and extreme rainfall for each river basin district, and provides advice on applying climate change projections in the FCERM. It is essential that land use planning decisions consider the impact of a changing climate where appropriate.

[5] Cabinet Office (2008) Sir Michael Pitt Report 'Learning lessons learned from the 2007 floods' http://www.environment-agency.gov.uk/research/library/publications/33889.aspx
[6] HMSO (2010) The Flood and Water Management Act 2010 http://www.legislation.gov.uk/ukpga/2010/29/contents
[7] Defra, Environment Agency (2011) The National Flood and Coastal Erosion Risk Management Strategy for England.
[8] Environment Agency (2010) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities

2.2.2 Local Flood Risk Management Strategy

As LLFAs, the London Boroughs of Croydon, Merton, Sutton and Wandsworth each have a statutory duty to develop, maintain, apply and monitor a strategy for local flood risk management in their respective administrative areas. The four London Boroughs, along with the Royal Borough of Kingston upon Thames and London Borough of Richmond upon Thames, each prepared a Local Flood Risk Management Strategy (LFRMS) in partnership in order to encourage collaboration and enable flood risk across South West London to be managed more effectively and holistically:

- London Borough of Croydon adopted their LFRMS in 2015;
- London Borough of Merton adopted their LFRMS in 2015;
- London Borough of Sutton's LFRMS has been approved by the committee and the summary documents have been published online; and
- London Borough of Wandsworth are currently undergoing consultation of their draft LFRMS 2014.

As part of the preparation of the LFRMSs, and their wider role as LLFA, each of the London Boroughs undertook an exercise to collate records of historic flooding. These records have been used to inform the Level 1 SFRA.

2.2.3 Surface Water Management Plans

A Surface Water Management Plan (SWMP) is a framework to understand the causes of surface water flooding and agree the most cost effective way of managing surface water flood risk. The main outputs are a co-ordinated Action Plan to prioritise projects to reduce surface water flood risk and detailed mapping of areas prone to surface water flood risk.

In 2010, the Greater London area was selected to receive UK Government funding to prepare SWMPs and Preliminary Flood Risk Assessments (PFRAs) for all 33 London Boroughs and develop on the ground solutions to surface water flooding across London. The Drain London project was established to deliver these tasks in a consistent and co-ordinated way across London, administered by the Greater London Authority (GLA).

- London Borough of Croydon, London Borough of Merton and London Borough of Sutton published their SWMPs in 2011;
- London Borough of Wandsworth published their SWMP in February 2012.

The flood risk mapping and records of historical flooding presented in the SWMPs for each of the four boroughs have been used to inform this Level 1 SFRA. In addition, the Critical Drainage Areas (CDAs) identified within the SWMPs have been reviewed and revised to further improve the understanding and management of surface water flood risk in the study area, as described further in paragraph 3.3.4.

2.3 Flood Risk Regulations

As well as the duties under the Act to prepare a LFRMS, LLFAs have legal obligations under the EU Floods Directive[9], which was transposed into UK Law through the Flood Risk Regulations 2009[10] ('the Regulations') as follows.

2.3.1 Preliminary Flood Risk Assessment

Under the Regulations, all LLFAs were required to prepare a Preliminary Flood Risk Assessment (PFRA) report. This is a high level screening exercise to identify areas of significant risk as Indicative Flood Risk Areas across England where 30,000 people or more are at risk from flooding for reporting to Europe. The administrative area of Greater London as a whole is shown to be included in an Indicative Flood Risk Area.

As part of the Drain London project, PFRAs were prepared for all London Boroughs in 2011[11]. The PFRA seeks to provide a high level overview of flood risk from local flood sources and includes flooding from surface water (i.e. rainfall resulting in overland runoff), groundwater, ordinary watercourses (smaller watercourses and ditches) and canals. It

[9] European Union (2007) EU Floods Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007L0060:EN:NOT
[10] HSMO (2009) The Flood Risk Regulations http://www.legislation.gov.uk/uksi/2009/3042/contents/made
[11] Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Merton; Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Wandsworth; Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Sutton; Greater London Authority, 2011, Preliminary Flood Risk Assessment for London Borough of Croydon

excludes flood risk from main rivers, the sea and reservoirs, as these are assessed nationally by the Environment Agency.

The PFRA report looks at past flooding and where future flooding might occur across the area and the consequences it might have to people, properties and the environment. The report provides a useful baseline for each London Borough to inform their LFRMS as well as the preparation of this revised Level 1 SFRA.

2.3.2 Thames River Basin District Draft Flood Risk Management Plan

Under the EU Floods Directive[9] and UK Flood Risk Regulations 2009[10], LLFAs must prepare FRMPs in formally identified Flood Risk Areas where the risk of flooding from local sources is significant (i.e. surface water, groundwater, ordinary watercourses), and the Environment Agency is required to prepare FRMPs for all of England covering flooding from main rivers, the sea and reservoirs.

As such, the Thames River Basin District FRMP[12] has been published for consultation by the Environment Agency and sets out the proposed measures to manage flood risk in the Thames River Basin District from 2015 to 2021 and beyond. This document draws on existing reports and plans which have been prepared in the past such as the Thames Catchment Flood Management Plan (CFMP) and the Thames Estuary 2100 Plan.

2.3.3 Thames Catchment Flood Management Plan

The Thames Catchment Flood Management Plan (CFMP) was published in 2008 and sets out policies for the sustainable management of flood risk across the whole catchment over the long-term (50 to 100 years) taking climate change into account. The Plan emphasises the role of the floodplain as an important asset for the management of flood risk, the crucial opportunities provided by new development and regeneration to manage risk, and the need to re-create river corridors so that rivers can flow and flood more naturally.

The study area is located within the CFMP sub-area 9 'London catchments'. The CFMP notes that in this area, the risk of flooding from rivers is typically managed by conveying water in concrete channels through urban areas. This approach is reliant upon river structures including culverts and trash screens, and this approach will become increasingly ineffective against storms which are anticipated to become more frequent and intense in the future. The CFMP also identifies other sources of flooding including the overflow of surface drains, the inundation of sewers and large areas of impermeable surfaces. Often these types of flooding can occur simultaneously which can make it difficult to determine the source.

The vision and preferred policy for this sub-area is Policy Option 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change. The Environment Agency has set out the following proposed actions to implement the preferred policy:

- *We will continue to make sure the recommendations in Strategic Flood Risk Assessments and Local Development Framework policies create the potential to reduce flood risk through regeneration.*
- *We will play our part in adopting a strategic approach to planning so that wider community objectives as well as flood risk objectives can be met.*
- *We will develop our emergency response planning to deal with extreme floods, including raising public awareness and working with key partners to identify critical infrastructure at flood risk.*
- *We want to continue to maintain the existing flood defences and when redevelopment takes place, replace and improve them so that they are more effective against the impacts of climate change. We will be looking to remove culverts and other structures that cause significant conveyance problems. An example of this is our work in the Ravensbourne catchment.*
- *With our partners, we will look for opportunities to reduce flood risk by recreating river corridors in urban areas. We will influence people who shape the urban environment and harness these opportunities, allowing space for water, habitat, wildlife and recreation.*

2.3.4 Thames Estuary 2100

The Thames Estuary 2100 (TE2100) plan sets out the strategic direction for managing flood risk in the Thames estuary to the end of the century and beyond. The relevant policies for those areas within London Borough of Wandsworth are covered by the policy units for Barnes and Kew, and Wandsworth to Deptford. For both of these policy units the selected policy is P5; to take further action to reduce flood risk beyond that required to keep pace with climate change.

[12] Environment Agency (October 2014) Thames River Basin District Consultation on the draft Flood Risk Management Plan https://consult.environment-agency.gov.uk/portal/ho/flood/draft_frmp/consult?pointId=3063510

The Plan states that in these areas a higher standard of protection will be provided by the Thames Barrier for tidal flood risk for the foreseeable future. Towards the end of the TE2100 appraisal demonstrates that given the commercial, economic and historic value of London, as well as the potential for loss of life in the unlikely event of a flood, a 1:10,000 year standard will be justified for P5 areas. In Wandsworth to Deptford, there may also be opportunities to set back defences and improve riverside amenity and habitats.

2.4 National Planning Policy Framework

The NPPF is a framework within which councils and local people can produce local and neighbourhood plans that reflect the needs and priorities of their communities. The overall approach of the NPPF to flood risk is broadly summarised Paragraph 103:

When determining planning applications, LPAs should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific FRA following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- ***within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location, and***
- ***development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems."***

Further detail regarding the Sequential and Exception Tests is included in Section 8 of this report and the Level 2 SFRA.

2.4.1 NPPF Guidance SuDS Policy (April 2015)

Sustainable Drainage Systems (SuDS) are an approach to managing rainwater and surface water that replicates natural drainage, the key objectives being to manage the flow rate and volume of runoff at source, in order to reduce risk of flooding and to improve water quality. From 6th April 2015, the Planning Practice Guidance for Flood Risk and Coastal Change (PPG) was amended to provide a stronger emphasis on the implementation of SuDS. LPAs (such as London Boroughs of Croydon, Merton, Sutton and Wandsworth) are required to ensure that SuDS are incorporated in all major development plans where appropriate, and through the use of planning conditions or planning obligations, make sure that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

LLFAs are statutory consultees for surface water drainage. As LLFAs, each local authority will need to be consulted on the drainage elements of planning applications for major development to ensure they take account of the Government's 'Sustainable Drainage Systems: Non-Statutory Technical Guidance'[13]. Further recommendations on the application of SuDS are provided in Section 10.

2.5 London Planning Policy

2.5.1 The London Plan (March 2015)

The London Plan March 2015[14] sets out an integrated economic, environmental, transport and social framework for the development of London over a 20-25 year period. This document, published in March 2015, is consolidated with all the alterations to the London Plan since 2011. It is likely that the London Plan and currently policies may change in 2016 after the election of a new London Mayor. The Plan includes a number of key policies aimed to assist protection of the water environment during redevelopment and construction. The following policies are of relevance to flood risk and drainage:

Policy 5.11 Green Roofs and Development Site Environs

A. Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:

[13] Sustainable drainage systems: non-statutory technical standards - https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

[14] Greater London Authority, March 2015, The London Plan The spatial development strategy for London consolidated with alterations since 2011.
http://www.london.gov.uk/sites/default/files/London%20Plan%20March%202015%20(FALP).pdf?bcsi_scan_E956BCBE8ADBC89F=eVEwLWlyeNQ5NoIGU5QMt08hDnPDAAAAgOMfEg==&bcsi_scan_filename=London%20Plan%20March%202015%20(FALP).pdf

a) adaptation to climate change (i.e. aiding cooling)

b) sustainable urban drainage

c) mitigation of climate change (i.e. aiding energy efficiency)

d) enhancement of biodiversity

e) accessible roof space

f) improvements to appearance and resilience of the building

g) growing food.

B. Within LDFs, boroughs may wish to develop more detailed policies and proposals to support the development of green roofs and the greening of development sites. Boroughs should also promote the use of green roofs in smaller developments, renovations and extensions where feasible.

Policy 5.12 Flood Risk Management

A. The Mayor will work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost effective way.

B. Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk[2] over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 (TE2100) and Catchment Flood Management Plans.

C. Developments which are required to pass the Exceptions Test set out in the NPPF and the Planning Practice Guidance will need to address flood resilient design and emergency planning by demonstrating that:

a) the development will remain safe and operational under flood conditions

b) a strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions

c) key services including electricity, water etc. will continue to be provided under flood conditions

d) buildings are designed for quick recovery following a flood.

D. Development adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible should aim to be set back from the banks of watercourses and those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way.

E. In line with the NPPF and the Planning Practice Guidance, boroughs should, when preparing LDFs, utilise Strategic Flood Risk Assessments to identify areas where particular flood risk issues exist and develop actions and policy approaches aimed at reducing these risks, particularly through redevelopment of sites at risk of flooding and identifying specific opportunities for flood risk management measures.

Policy 5.13 Sustainable Drainage

A. Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1) store rainwater for later use

2) use infiltration techniques, such as porous surfaces in non-clay areas

3) attenuate rainwater in ponds or open water features for gradual release

4) attenuate rainwater by storing in tanks or sealed water features for gradual release

5) discharge rainwater direct to a watercourse

6) discharge rainwater to a surface water sewer/drain

7) discharge rainwater to the combined sewer.

Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

B. Within LDFs boroughs should, in line with the Flood and Water Management Act 2010, utilise Surface Water Management Plans to identify areas where there are particular surface water management issues and develop actions and policy approaches aimed at reducing these risks.

2.5.2 Sustainable Design and Construction SPG (April 2014)

The Sustainable Design and Construction SPG[15] provides guidance on the implementation of London Plan policy 5.3 - Sustainable Design and Construction, as well as a range of policies relating to environmental sustainability. It is a key supporting document for the management of flood risk in London and the implementation of SuDS.

To support the flood related policies in the London Plan, the SPG includes guidance on:

- Surface water flooding and sustainable drainage, including Surface Water Management Plans (SWMP), Greenfield runoff rates, the multifunctional benefits of SuDS, management of SuDS and contributions;
- Flood resilience and resistance of buildings in flood risk areas;
- Flood risk management, including the design life of development, safety, and basements;
- Flood defences; and
- Other sources of flooding, including groundwater flooding, reservoir flooding and surface water flooding.

With regards to Greenfield runoff rates, the SPG states the following preferred standards:

" all developments on greenfield sites must maintain greenfield runoff rates. On previously developed sites, runoff rates should not be more than three times the calculated greenfield rate. The only exceptions to this, where greater discharge rates may be acceptable, are where a pumped discharge would be required to meet the standards or where surface water drainage is to tidal waters and therefore would be able to discharge at unrestricted rates provided unacceptable scour would not result".

However, if it is not practical to achieve greenfield runoff rates, the essential standards for runoff requires a minimum of 50% attenuation of the site's (prior to re-development) surface water runoff at peak times. Developers are required to demonstrate and justify why greenfield runoff rate cannot be achieved, and identify which methods/opportunities have been used to minimise final site runoff, as close to greenfield rate as practical. This should be done using calculations and drawings appropriate to the scale of the application.

[15] Mayor of London, 2014, Sustainable Design and Construction SPG, London Plan 2011 Implementation Framework.

2.6 Local Planning Policy

2.6.1 Croydon Local Planning Policy

The current Croydon Local Plan[16] was adopted in April 2013. The plan sets out the current development policies for the Borough and includes the following policies relevant to flood risk:

Policy SP6.4: Flood Risk

The Council, as a Lead Local Flood Authority, will work in partnership with the Environment Agency, community groups, water and highways infrastructure providers, developers and other Lead Local Flood Authorities to reduce flood risk, protect groundwater and aquifers, and minimise the impact of all forms of flooding in the borough. This will be achieved by:

a) Requiring major developments in Flood Zone 1 and all new development within Flood Zones 2 and 3 to provide site specific Flood Risk Assessments proportionate with the degree of flood risk posed to and by the development, taking account of the advice and recommendations within the Council's Strategic Flood Risk Assessment and Surface Water Management Plan;

b) Requiring all development, including refurbishment and conversions, to utilise sustainable drainage systems (SUDs) to reduce surface water runoff and provide water treatment on site; and

c) Requiring development proposals to account for possible groundwater contamination in Source Protection Zones 1 and 2.

Policy SP6.5: Blue Corridors and Water Management

The Council and its partners will promote the implementation of 'Urban Blue Corridors', enabling a network of multifunctional spaces and corridors that provide safe routes and storage for flood water within the urban environment.

This will be achieved by:

a) Supporting schemes that make space for water in flood events;

b) Supporting schemes to de-culvert sections of the River Wandle, Norbury Brook and Caterham Bourne;

c) Preserving and enhancing landscape, heritage and culture through protection and access improvements to the borough's ponds, open water and water heritage sites; and

d) Maximising opportunities to establish overland flow paths, surface water ponding areas, urban watercourse buffer areas and multi-use flood storage areas in locations of high surface water flood risk and critical drainage areas.

[16] London Borough of Croydon, April 2013, Croydon Local Plan Strategic Policies

2.6.2 Merton Local Planning Policy

The Merton Core Planning Strategy[17] was adopted in July 2011. The Core Strategy sets out the overall framework for regeneration and development in Merton and includes the following policies relevant to flood risk:

Policy CS 13: Open space, nature conservation, leisure and culture

e) Any proposals for new dwellings in back gardens must be justified against the:

i. local context and character of the site;

ii. biodiversity value of the site;

iii. value in terms of green corridors and green islands;

iv. flood risk and climate change impacts.

Policy CS 16: Flood Risk Management

Merton Council will:

a) Work with the Environment Agency, landowners and developers, based on the findings of the most recent Strategic Flood Risk Assessment and other plans, to manage and reduce flood risk from all sources of flooding;

b) Apply the sequential and exception tests to avoid inappropriate development in relation to flood risk;

c) Implement sustainable drainage systems (SUDs) across the borough and work towards effective management of surface water flooding;

d) Fully engage in flood risk emergency planning including the pre, during and post phases of flooding event;

e) Propose the implementation of measures to mitigate flood risk across the borough that are effective, viable, attractive, and enhance the public realm and ensure that any residual risk can be safely managed.

The Merton Sites and Policies Plan[18] was adopted in July 2014. It contains detailed planning policies which guide planning applications for development in Merton, implementing the more strategic principles set out in the Core Planning Strategy and London Plan. The Sites and Policies Plan includes the following policies relevant to flood risk:

Policy DM F1: Support for flood risk management

To minimise the impact of flooding in the borough the council will:

a) Encourage development to locate in areas of lower risk by applying the Sequential Test; any unacceptable development and land uses will not be permitted.

b) Ensure that flood resilient and resistant measures are incorporated into design of development proposals in any area susceptible to flooding to minimise and manage the risk of flooding.

c) Ensure that developments consider all sources of flooding from fluvial, groundwater, surface water runoff, ordinary watercourse, and sewer; and including the risks of flooding arising from and to the development.

d) All development proposals must have regard to the Strategic Flood Risk Assessment (SFRA) and the Local Flood Risk Management Strategy.

Permit appropriate development in Flood Zones 1, 2, 3a and 3b subject to meeting the criteria in the following table:

Flood Zones	Sequential Test	Exception Test	Flood Risk Assessment
Flood Zone 1 Low Risk: **This zone has 1 in 1000 or less annual probability of fluvial flooding or less (<0.1%) in any year.** No land development restrictions. (Except for areas that have been identified as having critical drainage problems by the Environment Agency).	Not applicable. (Except for areas that are within a Critical Drainage Area).	Not applicable.	Required for sites greater than 1 ha or other developments proposals where there is evidence of risk from other sources of flooding including surface water, groundwater, ordinary watercourses and sewer flooding.
Flood Zone 2 Medium Risk:	Required for all	Required for	Required for all development

[17] London Borough of Merton, July 2011, Core Planning Strategy.
[18] London Borough of Merton, July 2014, Sites and Policies Plan.

This zone has between 1 in 100 and 1 in 1000 annual probability of fluvial flooding (between 1% and 0.1%). In this zone self-contained residential units at basement level and bedrooms at basement level will not be permitted by the council without appropriate mitigation measures in line with Environment Agency guidance. All basement, basement conversions and basement extensions must: • have access and escape routes to a higher floor, including other emergency planning measures; and, • adopt flood resilient and resistant design techniques. Flooding from all sources (including surface and groundwater flooding) should be considered, where basements are proposed they must have mitigation measures as part of the development proposal and design layout to reduce the risk of flooding to and from the development and surrounding area.	developments (including minor development and change of use).	developments classed as 'highly vulnerable'.	proposals unless the development is for change of use from 'water compatible' to 'less vulnerable' Classification development.
Flood Zone 3a High Risk: **This zone has 1 in 100 annual probability or greater (>1%) of fluvial flooding.** Development proposals are constrained to 'water compatible', 'less vulnerable' and 'more vulnerable' classification. Development classed as 'Highly vulnerable' will not be permitted by the council in line with Environment Agency guidance. Residential basements: Self-contained residential basement and bedrooms at basement level will not be permitted by the council. All other basement, basement conversion and basement extensions must: • have access and escape routes to a higher floor, including other emergency planning measures; if an appropriate escape route cannot be provided then the basement proposal will not be permitted and • adopt appropriate resilient design techniques and appropriate flood mitigation measures.	Required for all developments.	Required for developments classed as 'more vulnerable' and 'essential infrastructure'.	Required for all development proposals.
Flood Zone 3b The functional floodplain will be protected by not allowing any form of development on undeveloped sites unless it is: • classed as 'water compatible' • For development of 'essential infrastructure' which has to be located in a flood risk area and where no alternative locations are available, should be developed safely, without increasing flood risk elsewhere and where possible reduce the flood risk overall. The council will only support redevelopment of existing developed sites if there is no greater flood risk than currently exists to the re-development or wider community. In accordance with the NPPF if, following the application	Required for developments classed as 'essential infrastructure'.	Required for developments classed as 'essential infrastructure'.	Required for development.

of the Sequential Test, it is not possible, consistent with the wider sustainability objectives, for development to be located in flood zones with lower probability of flooding: • The developer must demonstrate that the development provides a wider social, environment, and economical benefit to the wider community that outweighs the flood risk, as informed by the SFRA and, • Submit a site specific flood risk assessment which must demonstrate that the development will be safe for the life time of the build taking into account vulnerability of it users, without increasing the risk to the development and surrounding area; and where possible will reduce flood risk overall. Basements, basement extensions and conversion of basements to a 'higher vulnerability' classification or self-contained units will not be permitted by the council.			

Policy DM F2: Sustainable urban drainage systems (SuDS) and; wastewater and water infrastructure

The council will require all developments to reduce water consumption, the pressures on the sewer network and the risk of flooding by:

a) Ensuring all new developments have to consider SUDS and demonstrate sustainable approaches to the management of surface water in line with the emerging National SUDS standards.

b) Seeking mitigating measures against the impact of flooding from all sources; and surface water run-off through the inclusion of SUDS including green roofs rainwater harvesting and other innovative technologies where appropriate.

c) Ensuring developers demonstrate the maintenance and long-term management of SUDS through a SUDS Management Plan.

d) Requiring developers, where feasible, to incorporate soft landscaping, appropriate planting (including trees) and permeable surfaces into all new developments including non-residential developments.

For development proposals associated with existing homes, the council requires:

- The retention of soft landscaping and permeable surfaces in gardens and the reduction, or at least not the increase in, the amount of impermeable surface associated with existing homes
- New driveways or parking areas associated with non-residential developments and those located in gardens to be made of permeable material in line with permitted development rights

e) Requiring any development or re-development that impacts on a heritage asset or its setting (including conservation areas) has to consider SUDS and demonstrate within a Heritage Statement, the approach taken to ensure that there is no adverse impact on the character and appearance of the asset and that there is no long term deterioration to the building's fabric or fittings.

f) Requiring developers, when discharging water including wastewater into the public sewer, development proposals are required to demonstrate that the local public sewerage network has adequate capacity to serve the development and existing developments. If the public sewer does not have adequate capacity, the developer should demonstrate alternative sustainable approaches to the management of water.

g) Requiring any development proposals with adverse impact including potential water pollution will be refused by the council.

h) The development or expansion of water supply or waste water facilities will normally be permitted, either where needed to serve existing or proposed new development, or in the interests of long term water supply and waste water management, provided that the need for such facilities outweighs any adverse land use or environmental impact.

i) Requiring any new water supply, sewerage or waste water treatment infrastructure must be in place prior to occupation of the development. Financial contributions may be required for new developments towards the provision of, or improvements to such infrastructure.

Policy DM D2: Design considerations in all developments

a) Proposals for all development will be expected to meet all the following criteria:

i. Relate positively and appropriately to the siting, rhythm, scale, density, proportions, height, materials and massing of surrounding buildings and existing street patterns, historic context, urban layout and landscape features of the surrounding area;

ii. Use appropriate architectural forms, language, detailing and materials which complement and enhance the character of the wider setting;

iii. Provide layouts that are safe, secure and take account of crime prevention and are developed in accordance with Secured by Design principles;

iv. Ensure appropriate provision of outdoor amenity space, whether public, private or communal which accords with appropriate minimum standards and is compatible with the character of surrounding areas;

v. Ensure provision of appropriate levels of sunlight and daylight, quality of living conditions, amenity space and privacy, to both proposed and adjoining buildings and gardens;

vi. Protect new and existing development from visual intrusion, noise, vibrations or pollution so that the living conditions of existing and future occupiers are not unduly diminished;

vii. Ensure provision of appropriate energy efficient external lighting that provides safe and secure environments while not causing light pollution that adversely affects neighbouring occupiers or biodiversity;

viii. Conserve and enhance the natural environment, particularly in relation to biodiversity and wildlife habitats and gardens;

ix. Ensure trees and other landscape features are protected;

x. Ensure that landscaping forms an integral part of any new development where appropriate;

xi. Ensure the highest practical standards of access and inclusion and be accessible to people with disabilities;

xii. Ensure that construction waste is minimised and promote sustainable management of construction waste on-site by managing each type of waste as high up the waste hierarchy as practically possible;

xiii. Ensure that the traffic and construction activity do not adversely impact or cause inconvenience in the day to day lives of those living and working nearby, and do not harm road safety or significantly increase traffic congestion;

xiv. Ensure that sustainable design to make effective use of resources and materials, minimise water use and CO2 emissions are achieved by expecting these to be incorporated in the initial design stages.

Basements and subterranean developments

b) In addition, proposals for basement and subterranean developments will be expected to meet all the following criteria:

i. Be wholly confined within the curtilage of the application property and be designed to maintain and safeguard the structural stability of the application building and nearby buildings;

ii. Not harm heritage assets;

iii. Not involve excavation under a listed building or any garden of a listed building or any nearby excavation that could affect the integrity of the listed building, except on sites where the basement would be substantially separate from the listed building and would not involve modification to the foundation of the listed building such as may result in any destabilisation of the listed structure;

iv. Not exceed 50% of either the front, rear or side garden of the property and result in the unaffected garden being a usable single area;

v. Include a sustainable urban drainage scheme, including 1.0 metre of permeable soil depth above any part of the basement beneath a garden;

vi. Not cause loss, damage or long term threat to trees of townscape or amenity value;

vii. Accord with the recommendations of BS 5837:2012 'Trees in relation to design, demolition and

construction recommendations';

viii. Ensure that any externally visible elements such as light wells, roof lights and fire escapes are sensitively designed and sited to avoid any harmful visual impact on neighbour or visual amenity;

ix. Make the fullest contribution to mitigating the impact of climate change by meeting the carbon reduction requirements of the London Plan.

The Council will require an assessment of basement and subterranean scheme impacts on drainage, flooding from all sources, groundwater conditions and structural stability where appropriate. The Council will only permit developments that do not cause harm to the built and natural environment and local amenity and do not result in flooding or ground instability. The council will require that the Design and Access statement accompanying planning applications involving basement developments demonstrate that the development proposal meets the carbon reduction requirements of the London Plan.

2.6.3 Sutton Local Planning Policy

The current Sutton Core Planning Strategy[19] was adopted in December 2009, as part of the Sutton Local Development Framework. The Site Development Policies Development Plan Document (DPD)[20] provides additional detail and guidance on how the Core Planning Strategy will be implemented through decisions on planning applications. The strategy and DPD set out the current development policies for the Borough and includes the following policies relevant to flood risk:

Policy BP7 - Flood Risk and Climate Change Adaptation

Sutton Council will seek to avoid, manage and reduce all sources of potential flood risk to and from new development and adapt to the future impacts of climate change by:

a) Steering all site allocations and development towards areas of lowest flood risk through application of the 'Sequential Test', taking the vulnerability of the proposed uses into account;

b) Considering the suitability of sites within areas of higher flood risk only where it can be demonstrated that there are no reasonably available sites within Flood Zone 1 (low risk) appropriate to the type of use proposed;

c) Considering flood risk in line with PPS25 by ensuring that certain classes of development located within higher flood risk areas demonstrates compliance with the 'Exception Test' according to Table D3 of PPS25 by:

i. providing wider sustainability benefits that outweigh flood risks, and

ii. is safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall;

d) Requiring developers to assess the risks of all forms of flooding and identify options to mitigate these risks, taking climate change into account, through the preparation of site-specific FRAs where appropriate; and

e) Promoting the most effective adaptation to the impacts of climate change as part of new development, in accordance with the Mayor's drainage hierarchy, including SUDS, and its role in achieving wider sustainability benefits for biodiversity, water quality and local amenity.

Policy DM7 - Flood Risk

Proposed developments should assess and avoid or minimise all sources of flood risk to people and property where possible, and manage any residual risks, taking account of the future impacts of climate change, without increasing flood risk elsewhere by:

a) Preparing site-specific flood risk assessments (FRAs) in support of planning applications for all development proposals located within Flood Zones 2 or 3, all major development proposals located within Flood Zone 1 exceeding 1 ha or any development proposal located within an identified critical drainage area. FRAs should identify and assess the risks of all forms of flooding to and from the development and demonstrate how these flood risks will be managed now and in the future, taking climate change impacts into account, in line with the minimum FRA requirements set out in Annex E of Revised PPS25;

b) avoiding inappropriate development in areas at risk of flooding in accordance with the provisions of the sequential and exceptions tests set out in Annex D of Revised PPS25, having regard to the flood risk

[19] London Borough of Sutton, December 2009, LDF Core Planning Strategy.
[20] London Borough of Sutton, March 2012, LDF Core Planning Strategy, Site Development Policies DPD.

vulnerability classifications and flood zone compatibility guidance in tables D2 and D3 respectively;

c) applying the sequential approach at a site level to minimise risk by directing increasingly vulnerable development to areas of lowest flood risk, matching the vulnerability of the proposed use to flood risk, having regard to the 'Development and Flood Risk Practice Guide' to Revised PPS25 and further guidance to be set out in the Council's forthcoming Climate Change SPD;

d) incorporating appropriate sustainable urban drainage systems (SUDS) in order to manage surface water run-off as close to its source as possible and aiming to achieve greenfield run-off rates, in accordance with national SUDS standards, the Mayor's drainage hierarchy, SUDS adoption criteria to be established in the Council's forthcoming Climate Change SPD and other sources of best practice. All development proposals will be expected to incorporate green roofs, walls or site planting measures where feasible, and promote the benefits of blue and green infrastructure for flood storage, urban cooling, local amenity, biodiversity and other adaptation objectives in line with Policy DM8; and

e) ensuring that any residual risks are safely mitigated through the use of appropriate flood resistance and resilience measures, subject to having applied the sequential approach and incorporated SUDS in accordance with parts (a) to (d) above.

Policy DM8 - Climate Change Adaptation

(a) The Council will seek to ensure that the location, layout and design of proposed developments minimise vulnerability of people and property and are fully adapted and resilient to future climate impacts in accordance with Sutton's climate change adaptation Vision and key adaptation principles set out in the Borough Climate Change Adaptation Strategy, the Mayor's Climate Change Adaptation Strategy and the policies of the London Plan.

(b) Proposed developments should promote effective adaptation to the future impacts of climate change within the Borough by:

- Avoiding or minimising all sources of flood risk to people and property, managing any residual risks and, where possible, reducing flood risks overall, taking account of the future impacts of climate change, in accordance with Policy DM7;
- Minimising overheating and contribution to the urban heat island (UHI) effect by permeating developments with blue and green spaces and through a range of urban design measures at the neighbourhood and building scales, including energy efficient designs and natural cooling measures such as green roofs, green walls or site planting measures (required under Policy DM7), shading, water features, courtyards and passive ventilation;
- Conserving water resources and ensuring sufficient water supplies during drought conditions through maximising the flood storage role of rivers, natural floodplains, ponds, aquifers and other water features, promoting the benefits of suds for groundwater recharge and achieving higher standards of water efficiency in new development in accordance with Policy DM10;
- Conserving and enhancing the range and ecological variability of existing habitats and species to reduce the likelihood of losing biodiversity in the face of future climate change;
- Maximising the role of green infrastructure, including open spaces, parks, wildlife corridors, tree planting, communal and private gardens and green roofs/walls as part of wider green space networks ('green grid'), in urban cooling and in achieving a range of additional benefits for flood storage/SUDS, environmental enhancement, local amenity, recreation, biodiversity and habitats and sustainable transport;
- Maximising the role of blue infrastructure, including river corridors, natural floodplains, ponds and other water features in urban cooling and achieving a number of additional benefits for flood storage/SUDS, environmental enhancement, local amenity, recreation and biodiversity and habitats; and
- Taking account of the expected changes in local climatic conditions throughout the lifetime of the development by incorporating sufficient flexibility of design and layout to enable adaptation to the future impacts of climate change and other changing economic, environmental or social demands.

(c) Details of the type and extent of the main changes expected in the local climate throughout the lifetime of the development and the proposed climate change adaptation measures should be provided in the Sustainable Design and Construction Statement (or Design and Access Statement) prepared in accordance with Policy DM5 and any site specific flood risk assessments (FRA) prepared in accordance with Policy DM7 as appropriate.

2.6.4 Wandsworth Local Planning Policy

The Wandsworth Core Strategy (2nd proposed submission version)[21] and Development Management Policies Document (DMPD) (2nd proposed submission version)[22], were published in October 2014 and are due to be adopted in March 2016. These documents set out the current development policies for the Borough and include the following policies relevant to flood risk, however these policies will change in March 2016, when the Local Plan is adopted:

Policy PL2: Flood Risk

a) The development of appropriate sites within Flood Zones 2, 3a and 3b in the Wandle Valley and the Thames riverside will be permitted in principle in terms of the Sequential Test. However, proposals for individual sites within these flood zones must comply with the Exceptions Test set out in the National Planning Practice Guidance. Development proposals, excepting some minor proposals will require a Flood Risk Assessment (FRA) to be undertaken, taking account of the Strategic Flood Risk Assessment, the Local Flood Risk Management Strategy, the Surface Water Management Plan and the Preliminary Flood Risk Assessment for the borough.

b) Where development is permitted within a flood risk areas it must demonstrate that where possible, it will reduce fluvial, tidal, surface water and groundwater flood risk and manage residual risks through appropriate flood risk measures. Tidal flood risk will be managed in accordance with the measures set out in the Thames Estuary 2100 (TE2100) Plan 2012.

c) A site specific Flood Risk Assessment will be required for proposed development of 1 hectare or greater in Flood Zone 1, all proposed development (including minor development and change of use) within Flood Zones 2 and 3 (3a and 3b), and any development at risk from other sources of flooding.

d) Site specific Flood Risk Assessments should consider flooding from all sources including tidal, fluvial, surface water, groundwater, sewer and artificial sources.

Policy PL9: River Thames and the riverside

a) Along the riverside in the Thames Policy Area mixed use redevelopment will be promoted in order to create safe attractive environments, provide new homes, jobs, leisure and social infrastructure facilities with public spaces at focal points, a riverside walk and cycle way and increased public access to the river. Development next to or opposite safeguarded wharves should be designed to minimise the potential for conflicts of use and disturbance.

b) Greater use will be made of the river. The efficient operation of the wharves will be supported through the protection of routes to the main road network serving protected wharves. Five wharves will continue to be safeguarded for the transhipment of freight, including waste and aggregates, and for freight related activities. The redevelopment of safeguarded wharves should only be accepted if the wharf is no longer viable or capable of being made viable for cargo handling uses. Assessments as to whether a wharf is or can be viable will be made using the criteria set out in para 4.163 7.77 of the London Plan 20082011.

c) Existing river infrastructure that provides access to the river and the foreshore, such as piers, jetties, drawdocks, slipways, steps and stairs will be protected and new facilities, including piers for riverbuses, promoted. Enhanced riverbus services will be promoted and supported (see also Policies PL3 and IS1 and DMPD Policy DMO7).

d) Putney Embankment's special recreational character and function, particularly in connection with river sports, will continue, with facilities and activities which contribute to this character supported and protected.

e) Development will not be permitted which encroaches onto the river foreshore or which harms the stability or continuity of flood defences. Opportunities will be taken, in consultation with partner agencies such as Natural England, the Port of London Authority and the Environment Agency, to create habitat and reduce flood risk.

f) Measures to protect and enhance the river as a valuable resource for wildlife and biodiversity, including wildlife corridors and green chains, will be supported, in particular at the mouth of the River Wandle.

Policy PL10: The Wandle Valley

a) Sites within the Wandle Valley will continue to provide a strategic reservoir of land for employment uses, including logistics, services and industry, and for future waste management facilities, subject to flood risk assessment.

b) Improved accessibility within the corridor and to the riverside will be pursued including the provision of

[21] London Borough of Wandsworth, October 2014, Wandsworth Core Strategy (2nd proposed submission version)
[22] London Borough of Wandsworth, October 2014, Development Management Policies Document (DMPD) (2nd proposed submission version)

pedestrian and cycle ways.

c) Opportunities for formal and informal recreation that support the vision of the Wandle Valley Regional Park will be developed, including within King George's Park and north of Wandsworth town centre to the Wandle mouth (see section on central Wandsworth and the Wandle Delta).

d) Measures to protect and enhance the River Wandle as a valuable resource for wildlife and biodiversity, including wildlife corridors and green chains, will be supported.

Policy IS 2: Sustainable design, low carbon development and renewable energy

a) The Council supports measures to improve energy conservation and efficiency and contributions to renewable energy generation. All development will be required to make efficient use of natural resources (e.g. energy and water), employing good standards of sustainable design and construction, including sustainable drainage, working towards low carbon and zero carbon standards.

b) The Council will use the National Planning Policy Framework and London Plan policies, including those on green infrastructure, flood risk, sustainable drainage and water quality and the standards in the London Plan Supplementary Planning Guidance on Sustainable Design and Construction to ensure the overall sustainability of the site.

Policy IS 4: Protecting and enhancing environmental quality

The Council will support measures to protect and enhance the environmental quality of the borough and work with partner agencies to help deliver this. In particular measures will be taken to:

Mitigate the impact of flood risk in line with the findings of the Strategic Flood Risk Assessment.

Policy DMS5: Flood risk management

If applicants can demonstrate through a site specific FRA that their site would be unaffected by all forms of flood risk including tidal, groundwater, fluvial and pluvial flood risk, the development restrictions set out in this table do not apply. Exceptions to this are some basement developments in Flood Zone 3b (see table below).

Applications for minor development (See NPPF footnote 10 for definition of minor development) and changes of use are not subject to the Sequential or Exception Test.

Where a Flood Risk Assessment is required, all sources of flooding including groundwater, surface water and sewer flooding, and historic flood mapping are required to be considered within the FRA to determine the risk of flooding from sources other than fluvial and/or tidal, and for appropriate mitigation measures to be proposed as necessary.

The Flood Risk Assessment will be required to consider how the development will remain safe during a flood and how development would recover from a flood. Developers will be required to make future tenants or freeholders aware of the likelihood and possible impact of flooding on the property, how to receive flood warnings and what action should be taken should a warning be received or a flood occur. In some cases it may be necessary to develop a capability within the property for affected people to stay in a safe place for 72 hours whilst the area is flooded. This information should be contained within a flood evacuation plan.

Development in Flood Zones 1, 2, 3a and 3b will be permitted subject to meeting the criteria in the following table:

Flood Zone	Land use and development restrictions
Flood Zone 3b (Functional Floodplain)	On undeveloped sites, planning permission will not be permitted unless it is for: • Water compatible development; • Essential Infrastructure. Excluding development for water-compatible development and essential infrastructure, redevelopment of existing developed sites, including proposals for the change of use or conversion to a use with a like for like vulnerability classification, will only be supported if there is an overall net flood risk reduction. Changes of use or conversion to a higher vulnerability classification will not be permitted. Safe refuge is required above the 1 in 200 year tidal flood level (including climate change) (or appropriate extreme water level as advised by the Environment Agency) or the 1 in 100 year fluvial flood level (including climate change). Safe access and egress (must be low hazard in accordance with FD2320) is required for all sites. Conversions of basements to a higher vulnerability classification or self-contained units will not be permitted. Habitable rooms will not be permitted in basements. All basements, basement extensions and basement conversions must have safe access threshold levels and internal staircases provided to access floors above the 1 in 200 year tidal flood level (including climate change) (or appropriate extreme water level as advised by the Environment Agency) or the 1 in 100 year fluvial flood level

	(including climate change). Where basements are proposed they should also include storage for surface water and/or other SuDS proposals as set out in Policy DMS6. See DMPD Policy DMH5 for the policy on garden development. **Sequential Test -** Required for all development, except if the site and its proposed use has already passed the sequential Test informed by the SFRA as completed by the Council, and/or the site is located within the Nine Elms Opportunity Area. **Exception Test -** Required for all development except water compatible development. **Flood Risk Assessment -** Required for all development proposals.
Flood Zone 3a (High Probability)	Acceptable land uses are: • Water-compatible; • Less vulnerable development; • More vulnerable development. For development in defended tidal areas (River Thames and Wandle Delta area) a. Floor levels for more vulnerable development with a sleeping element are required to be raised above the 1 in 200 year tidal flood level (including climate change) or appropriate extreme water level as advised by the Environment Agency. Depending on the flood level and comparison of site levels, this may not preclude ground floor residential use subject to the inclusion of satisfactory flood risk mitigation measures to be agreed with the Environment Agency. b. Safe refuge above the 1 in 200 year tidal flood level (including climate change) (or appropriate extreme water level as advised by the Environment Agency) or safe access and egress (must be low hazard in accordance with FD2320) is required for all sites to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood. c. All basements, basement extensions and basement conversions must have safe access threshold levels and internal staircases provided to access floors above the 1 in 200 year tidal flood level (including climate change) or appropriate extreme water level as advised by the Environment Agency. d. Self-contained residential basements and bedrooms at basement level will not be permitted. For development in undefended fluvial areas (River Wandle and Beverley Brook) e. Floor levels for more vulnerable development with a sleeping element are required to be raised over the 1 in 100 year fluvial flood level (including climate change) plus an additional 300mm freeboard depending on the source of flood risk to be agreed with the Environment Agency. Depending on the flood level and comparison of site levels, this may not preclude ground floor residential use subject to the inclusion of satisfactory flood risk mitigation measures to be agreed with the Environment Agency. Floor levels for undefended less vulnerable developments should also be raised in accordance with this standard. f. Safe refuge above the 1 in 100 year fluvial flood level (including climate change) or safe access and egress (must be low hazard in accordance with FD2320) is required for all sites to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry our any necessary duties during periods of flood. g. All basements, basement extensions and basement conversions must have safe access threshold levels and internal staircases provided to access floors above the 1 in 100 year fluvial flood level (including climate change). h. Self-contained residential basements and bedrooms at basement level will not be permitted. See DMPD Policy DMH5 for the policy on garden development. **Sequential Test -** Required for all development, except if the site, and its proposed use, has already passed the Sequential Test informed by the SFRA as completed by the Council, and/or the site is located within the Nine Elms Opportunity Area. **Exception Test -** Required for more vulnerable development. **Flood Risk Assessment -** Required for all development proposals.
Flood Zone 2 (Medium	No land use restrictions. For development in defended tidal areas (River Thames and Wandle Delta area)

Probability)	a. Floor levels for more vulnerable development with a sleeping element are required to be raised above the 1 in 200 year tidal flood level (including climate change) or appropriate extreme water level as advised by the Environment Agency. Depending on the flood level and comparison of site levels, this may not preclude ground floor residential use subject to the inclusion of satisfactory flood risk mitigation measures to be agreed with the Environment Agency. b. Safe refuge above the 1 in 200 year tidal flood level (including climate change) (or appropriate extreme water level as advised by the Environment Agency), or safe access and egress (must be low hazard in accordance with FD2320) is required for all sites to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood. c. All basements, basement extensions and basement conversions must have safe access threshold levels and internal staircases provided to access floors above the 1 in 200 year tidal flood level (including climate change) or appropriate extreme water level as advised by the Environment Agency. d. Self-contained residential basements and bedrooms at basement level will not be permitted. For development in undefended fluvial areas (River Wandle and Beverley Brook) e. Floor levels for more vulnerable development with a sleeping element are required to be raised above the 1 in 100 year fluvial flood level (including climate change) plus an additional 300mm freeboard depending on the source of flood risk to be agreed with the Environment Agency. Depending on the flood level and comparison of site levels, this may not preclude ground floor residential use subject to the inclusion of satisfactory flood risk mitigation measures to be agreed with the Environment Agency. Floor levels for undefended less vulnerable developments should also be raised in accordance with this standard. f. Safe refuge above the 1 in 100 year fluvial flood level (including climate change) or safe access and egress (must be low hazard in accordance with FD2320) is required for all sites to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood. g. All basements, basement extensions and basement conversions must have safe access threshold levels and internal staircases provided to access floors above the 1 in 100 year (including climate change) fluvial flood level. h. Self-contained residential basements and bedrooms at basement level will not be permitted. Where basements are proposed surface water flooding should be considered with potential mitigation to include raising access floor level thresholds, providing storage for surface water and/or other SuDS proposals as set out in Policy DMS6. See DMPD Policy DMH5 for the policy on garden development. **Sequential Test -** Required for all development, except if the site and its proposed use has already passed the Sequential Test informed by the SFRA as completed by the Council, and/or the site is located within the Nine Elms Opportunity Area. **Exception Test -** Required for all highly vulnerable development. **Flood Risk Assessment -** Required for all development proposals.
Flood Zone 1 (Low Probability)	No land use restrictions. Where basements are proposed surface water, groundwater and sewer flooding should be considered with potential mitigation to include raising access floor level thresholds, providing storage for surface water and/or other SUDS proposals as set out in Policy DMS6. See DMPD Policy DMH5 for the policy on garden development. **Sequential Test -** Not applicable **Exception Test -** Not applicable **Flood Risk Assessment -** Required for sites greater than 1 hectare in area. Required for all other development proposals where there is evidence of a risk from other sources of flooding, including surface water, groundwater and sewer and artificial sources. For the purposes of considering the risk of surface water flooding, Flood Risk Assessments should be undertaken for all sites where flooding in a 1 in 30 event is predicted to result in flood depths exceeding 300mm.

Policy DMS6: Sustainable Drainage Systems

a) As outlined in Policy DMS3, all new developments should seek to incorporate Sustainable Drainage Systems (SuDS) or demonstrate alternative sustainable approaches to the management of surface water. Applications for developments located within Flood Zones 2, 3a and 3b, 1ha in size or greater, or where flooding in a 1 in 30 event is predicted to result in flood depths exceeding 300mm in Flood Zone 1 must be accompanied by a Flood Risk Assessment which addresses the criteria listed below. All other developments should have regard to the following criteria:

i. application of a site wide sequential approach to development by locating buildings within the areas of lowest flood risk on a site in accordance with the areas set out within the LFRMS as areas with increased risk of surface water flooding;

ii. determination of potential overland flow paths and proposals for appropriate solutions to minimise the impact of development on surface water flooding. Road and building configuration should be considered to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere;

iii. application of SuDS measures to achieve at least 50% attenuation, aiming for 100% attenuation of the undeveloped (existing) sites' surface water run off at peak times, in accordance with the preferred standard in the Mayor's Sustainable Design and Construction SPG. Applications for development in sites located within Critical Drainage Areas set out in the Surface Water Management Plan/LFRMS should provide a drainage strategy outlining how surface water will be managed to demonstrate the safe attenuation of surface water utilising SuDS where possible, for rainfall events up to the 1 in 100 year plus climate change level;

iv. in areas with increased risk of surface water flooding within Critical Drainage Areas, a FRA should contain measures to mitigate off site surface water flooding by aiming to achieve greenfield runoff rates (8 litres per second per hectare) or better. SuDS techniques should be applied with regard to the London Plan Sustainable Drainage Hierarchy outlined in Policy 5.13, or such guidance as supersedes it. Demonstrable justification should be provided on the extent to which each measure is being proposed;

v. incorporation of soft landscaping and permeable surfaces into all new residential and non-residential developments. Retention of soft landscaping and permeable surfaces in front gardens and other means of reducing, or at least not increasing, the amount of hard standing associated with existing homes is encouraged. New driveways or parking areas associated with non-residential developments and those located in front gardens should be made of permeable material; consideration of the vulnerability and importance of local ecological resources (such as water quality and biodiversity) when determining the suitability of drainage strategies/SuDS;

vi. demonstration of the maintenance and long term management of SuDS through a SuDS Management Plan which should outline the on-going maintenance responsibilities and the measures to be put in place to undertake these. A Section 106 agreement or planning condition may be required to agree the long term management responsibilities of SuDS.

Where appropriate in new developments, Wandsworth Council will seek contributions towards flood protection measures and SuDS, in accordance with Core Strategy Policy IS 7, the Planning Obligations SPD and the CIL Regulations.

Policy DMS7: Consultation with the Environment Agency

a) The Environment Agency should be consulted on all developments adjacent to watercourses, as their consent is required for any works within 16m from the landward side of the River Thames flood defences and 8m from fluvial watercourses including the River Wandle and Beverley Brook.

b) The Environment Agency should be consulted for any development that could affect flood defence infrastructure.

c) Setting back developments from river banks and existing flood defence infrastructure, where there are opportunities to do so, will be encouraged.

d) Developments should take into account the requirements of the Thames Estuary 2100 (TE2100) Plan in regards to the implementation of current and future improvements to the River Thames tidal flood defences in order to effectively manage tidal flood risk over the plan period.

2.7 River Wandle Catchment Plan

The River Wandle Catchment Plan (2014)[23] has been developed by the Wandle Trust in partnership with the Environment Agency, Natural England, WWF-UK, Thames Water, Sutton & East Surrey Water, London Boroughs of Wandsworth, Merton, Sutton and Croydon, London Wildlife Trust, National Trust (Morden Hall Park), Wandle Valley Regional Park Trust, Beddington Farmlands, The Angling Trust, and The Rivers Trust. It follows the Environment Agency's catchment-based approach for river management, and is intended to help the Wandle to achieve 'Good Ecological Potential' in order to meet the UK's obligations under the EU Water Framework Directive (2000/60/EC).

The River Wandle Catchment Plan has identified the following aims for sustainably improving the health of the Wandle, and its value to local people:

- Water: the river's water should be plentiful and clean, and varied in its flow speeds, widths and depths.
- Habitat and wildlife: the river should support a mosaic of habitats with high biodiversity.
- Good access: local people should be able to access sympathetically managed pathways along the whole river.
- Engagement: everyone in the catchment should be aware of the river, and knows how their actions can affect it, with councils, businesses, government agencies and the public working together to improve the river.

2.8 Summary

Figure 2-1 provides a summary of the documents that have been reviewed within this section. It identifies that the main driver for the SFRA is the NPPF, and that documents and plans prepared by both the Environment Agency and each of the London Boroughs under the requirements of the FWMA and the Flood Risk Regulations, provide key inputs to inform the preparation of the revised SFRA and Local Plans.

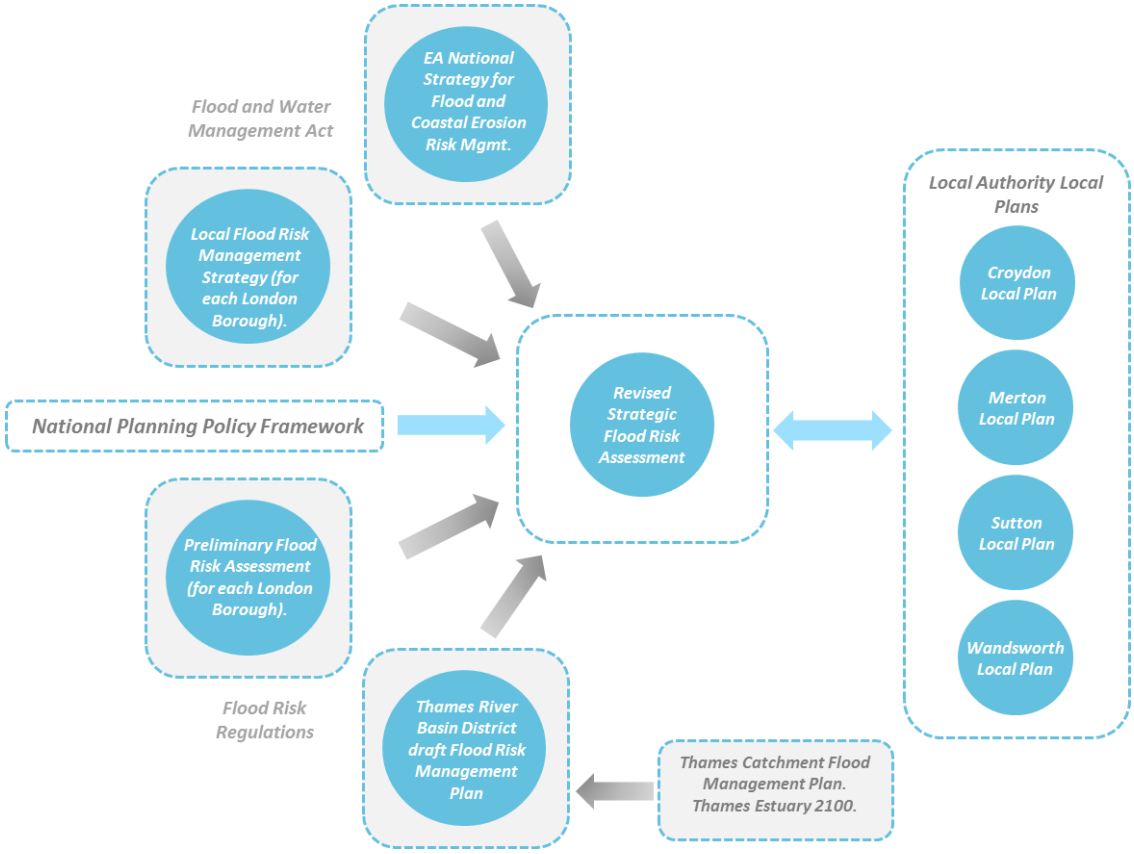


Figure 2-1 Summary of Legislative and Planning Context

[23] The Wandle Trust (2014) River Wandle Catchment Plan http://www.wandletrust.org/wp-content/uploads/2014/12/Wandle_Catchment_Plan_-_Sept_2014_-_full_document.pdf?bcsi_scan_e956bcbe8adbc89f=0&bcsi_scan_filename=Wandle_Catchment_Plan_-_Sept_2014_-_full_document.pdf

3 Level 1 SFRA Methodology

3.1 Level 1 SFRA Approach

The Level 1 SFRA is a desk-based study, using readily available existing information and datasets to enable the application of the Sequential Test and to identify where the Exception Test may be required. The main tasks in preparing the Level 1 SFRA are described below.

3.1.1 Establishing relationships and understanding the planning context

Upon project commencement, a stakeholder workshop was held to facilitate relationships between the project team, the client group, and third party stakeholders. Representatives from the following organisations were in attendance; London Boroughs of Croydon, Merton and Sutton, the Environment Agency, Network Rail, Sutton and East Surrey Water, and the Wandle Trust. The purpose of the meeting was to aid collaborative working and the free exchange of available information and datasets. AECOM provided an overview of the current planning context with respect to the preparation of the SFRA and the main flood risk issues in the area were identified and discussed. Discussions were also held with representatives of TWUL, and the British Geological Survey at the project start-up phase to enable information held by these organisations to be included in the study.

3.1.2 Gathering data and analysing it for suitability

Under Section 10 of NPPF, the risk of flooding from all sources must be considered as part of a Level 1 SFRA, including flooding from tidal sources, rivers (fluvial), land (overland flow and surface water), groundwater, sewers and artificial sources.

In order to provide this assessment of all sources of flooding in the study area, an extensive set of datasets was provided or relicensed for use. This information was subject to a quality review and gap analysis by the project team to determine the best datasets for inclusion in the Level 1 SFRA update. This Section provides further detail on each of the datasets provided, there uses and limitations and how they have been used within the Level 1 SFRA.

3.1.3 Producing strategic flood risk maps, GIS deliverables and a technical report

A series of GIS maps have been produced using the data gathered during the initial part of the study. The mapping deliverables are summarised in Table 3-1 and have been grouped by borough.

Table 3-1 Strategic Flood Risk Maps

Figure No.	Figures Title and Content
Figure 1.0	Study Area *(Borough boundaries, watercourses, water bodies, flood storage areas)*
Figure 2.1, Inset 1 & 2 (Croydon) Figure 3.1, Inset 1 & 2 (Merton) Figure 4.1, Inset 1 & 2 (Sutton) Figure 5.1, Inset 1 & 2 (Wandsworth)	Flood Zones *(Flood zones, watercourses, historic records of fluvial flooding, emergency rest centres, Environment Agency Asset Management Information System (AIMS))*
Figure 2.2 (Croydon) Figure 3.2 (Merton) Figure 4.2 (Sutton) Figure 5.2 (Wandsworth)	Updated Flood Map for Surface Water *(uFMfSW, historic records of surface water flooding*
Figure 2.3 (Croydon) Figure 3.3 (Merton) Figure 4.3 (Sutton) Figure 5.3 (Wandsworth)	Drainage Catchments *(Drainage Catchment (DC) boundaries, and uFMfSW)*
Figure 2.4 (Croydon) Figure 3.4 (Merton) Figure 4.4 (Sutton) Figure 5.4 (Wandsworth)	Susceptibility to Groundwater Flooding *(BGS Susceptibility to Groundwater Flooding dataset, historic records of groundwater flooding)*

Figure 2.5 (Croydon) Figure 3.5 (Merton) Figure 4.5 (Sutton) Figure 5.5 (Wandsworth)	Sewer Flooding *(TWUL DG5 register of internal and external sewer flooding records, historic records of sewer flooding)*
Figure 2.6 (Croydon) Figure 3.6 (Merton) Figure 4.6 (Sutton) Figure 5.6 (Wandsworth)	Flood Warning Areas *(Flood Warning Areas, Emergency Rest Centres)*
Figure 5.7 (Wandsworth only)	Tidal Breach Model Hazard Mapping for MLWL for the Year 2014
Figure 5.8 (Wandsworth only)	Tidal Breach Model Hazard Mapping for MLWL for the Year 2065
Figure 5.9 (Wandsworth only)	Tidal Breach Model Hazard Mapping for MLWL for the Year 2100

3.1.4 Providing suitable guidance

Once the process of preparing the Level 1 SFRA was underway, a second stakeholder workshop was help with representatives from AECOM, each of the four London Boroughs and the Environment Agency. The purpose of the workshop was to confirm an appropriate approach for the definition and use of Critical Drainage Areas and Drainage Catchments within the SFRA; to agree a methodology for applying the Sequential Test considering all sources of flooding; and to determine an appropriate definition of Flood Zone 3b across the study area.

The outcomes from the workshop and subsequent discussions have been used to inform the Level 1 Report. In particular, Section 8 of this report which provides guidance for the Councils on the application of the Sequential Test, and Section 12 which provides recommendations for flood risk policy considerations.

Further guidance is also presented in Sections 9-11 regarding measures to manage and mitigate flood risk; the application of SuDS; and the process of preparing site specific FRAs. It is intended that this guidance will be used by those preparing applications, as well as Development Management Officers considering applications at each of the Councils.

The remainder of this Section (sub-sections 3.2 – 0) provides a description of each of the datasets that have been obtained to inform the strategic assessment of flood risk from each of the sources of flooding outlined in the NPPF.

3.2 Flooding from Rivers and Sea

3.2.1 Detailed River Network

The Environment Agency 'Detailed River Network' dataset has been used to identify watercourses in the study area and their designation (i.e. main river or ordinary watercourse). There are a number of main rivers and ordinary watercourses within the study area, as described in Section 1.4.3, the approximate location of which are shown in **Appendix A Figure 1.0.**

3.2.2 Historic Records of River and Tidal Flooding

Over the last few years, information on historical flooding in the study area has been gathered as part of the preparation of the PFRA, SWMP and most recently the LFRMS. Incidents of property and highway flooding have been provided to Councils from local residents and businesses, Network Rail, Transport for London as well as the Environment Agency. Where possible, the source of the flooding has been identified. Records of flooding which are reported to be from a tidal or fluvial source are presented in **Appendix A Figure 2.1, Figure 3.1, Figure 4.1 and Figure 5.1.**

As well as some point data, the Environment Agency has provided an extract from the 'Recorded Flood Outlines' and 'Historic Flood Map' datasets for the study area[24]. The Historic Flood Map dataset for each London Borough is also presented in **Appendix A Figure 2.1, Figure 3.1, Figure 4.1 and Figure 5.1.**

3.2.3 NPPF Flood Zones

The risk of flooding is a function of the probability that a flood will occur and the consequence to the community or receptor as a direct result of flooding. The NPPF seeks to assess the probability of flooding from rivers by categorising areas within the fluvial floodplain into zones of low, medium and high probability, as defined in Table 3-2.

[24] The 'Recorded Flood Outlines' dataset identifies the flood extents associated with specific flood events. The 'Historic Flood Map' shows greatest extent of past flooding and does not identify individual flood events.

Table 3-2 Fluvial Flood Zones (extracted from the NPPG, 2014)

Flood Zone	Fluvial Flood Zone Definition	Probability of Flooding
Flood Zone 1	Land having a less than 1 in 1,000 (0.1%) annual probability of river flooding. Shown as clear on the Flood Map – all land outside Flood Zones 2 and 3.	Low
Flood Zone 2	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (between 1% and 0.1% annual probability of flooding each year).	Medium
Flood Zone 3a	Land having a 1 in 100 or greater annual probability of river flooding (greater than 1% annual probability of flooding each year).	High
Flood Zone 3b	Land where water has to flow or be stored in times of flood, or land purposely designed to be flooded in an extreme flood event (0.1% annual probability). The functional floodplain is not separately distinguished from Flood Zone 3a on the EA Flood Map for Planning (Rivers and Sea). LPAs are required to identify areas of functional floodplain as part of their SFRA, in discussion with the Environment Agency. For the purposes of this SFRA, the identification of the functional floodplain takes into account local circumstances and land modelled to flood during a 5% AEP event or greater in any year has been mapped, in agreement with the Environment Agency.	Functional Floodplain

The 'Flood Map for Planning (Rivers and Sea)' is available on the Environment Agency website[25] and is the main reference for planning purposes as it contains Flood Zones 1, 2 and 3 which are referred to in the NPPF and presented in Table 3-2. The 'Flood Map for Planning (Rivers and the Sea)' provides information on the areas that would flood if there were no flood defences or buildings in the "natural" floodplain.

The 'Flood Map for Planning (Rivers and Sea)' also identifies areas which, in the event of a river flood with a 1% AEP, or a tidal flood with a 0.5% AEP, would be protected from flooding by the presence of flood defences. These areas are described as 'Areas Benefitting from Defences' (ABD).

The 'Flood Map for Planning (Rivers and Sea)' was first developed in 2004 using national generalised modelling (JFLOW) and is now routinely updated and revised using the results from the Environment Agency's programme of catchment studies, entailing topographic surveys and hydrological and/or hydraulic modelling as well as previous flood events. Most recently, a remodelling study for the River Wandle has just been completed and provided for use within this Level 1 SFRA.

It should be noted that the scope of these modelling studies typically covers flooding associated with main rivers, and therefore ordinary watercourses that form tributaries to the main rivers may not always be included in the model. Modelling of ordinary watercourses available on the 'Flood Map for Planning (Rivers and Sea)' may be the result of the national generalised JFLOW modelling carried out by the Environment Agency and may need to be refined when determining the probability of flooding for an individual site and preparing a site-specific FRA. Further detail regarding the scope of site specific FRAs is provided in the Level 2 SFRA.

Flood zones have been provided by the Environment Agency for the study area and are presented in **Appendix A Figure 2.1, Figure 3.1, Figure 4.1 and Figure 5.1.**

It is noted that a separate map is available on the Environment Agency website which is referred to as 'Risk of Flooding from Rivers and Sea'[26]. This map takes into account the presence of flood defences and so describes the actual chance of flooding, rather than the change if there were no defences present. While flood defences reduce the level of risk they don't completely remove it as they can be overtopped or fail in extreme weather conditions, or if they are in poor condition. As a result the maps may show areas behind defences which still have some risk of flooding. This mapping has been made available by the Environment Agency as the primary method of communicating flood risk to members of the public, however for planning purposes the 'Flood Map for Planning (Rivers and the Sea)' and associated flood zones remains the primary source of information.

[25] Environment Agency Flood Map for Planning (Rivers and Sea) http://apps.environment-agency.gov.uk/wiyby/37837.aspx
[26] Environment Agency 'Risk of Flooding from Rivers and Sea' http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap#x=237038&y=161974&scale=1

3.2.4 Functional Floodplain Flood Zone 3b

The Functional Floodplain is defined in the NPPF as 'land where water has to flow or be stored in times of flood'. The Functional Floodplain (also referred to as Flood Zone 3b), is not separately distinguished from Flood Zone 3a on the Flood Map for Planning (Rivers and Sea). Rather the SFRA is the place where LPAs should identify areas of Functional Floodplain in discussion with the Environment Agency.

The PPG states that the identification of Functional Floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5% AEP) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point for consideration. The guidance goes on to say that 'areas which would naturally flood with an annual probability of 1 in 20 or greater, but are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain'.

As part of the Level 1 SFRA, the River Wandle and Beverley Brook modelling results for the 5% AEP event have been reviewed to determine their suitability for defining the Functional Floodplain. Each London Borough has reviewed this information where it is available for main rivers, and revised the extent where necessary, to account for the presence of existing infrastructure or solid buildings that should not be considered part of Flood Zone 3b Functional Floodplain. The approaches adopted by each of the four boroughs to defining the Flood Zone 3b boundaries are described below.

London Borough of Croydon and London Borough of Wandsworth have not removed any buildings from the 5% AEP event flood extent for the River Wandle and Beverley Brook.

London Borough of Sutton has not removed any buildings from the 5% AEP event flood extent for the River Wandle and Beverley Brook, as it cannot be verified that finished floor levels are high enough to prevent inundation.

London Borough of Merton has applied the following criteria to the removal of buildings from the 5% AEP event flood extents on the Beverley Brook and River Wandle:

- All residential and school buildings have been removed.
- Commercial (i.e. less vulnerable) buildings which have less than 50% coverage of 1 in 20 year have been removed.

These approaches have been discussed with and agreed by the Environment Agency. The extent of Flood Zone 3b for each London Borough is shown in **Appendix A Figure 2.1, Figure 3.1, Figure 4.1 and Figure 5.1.**

3.2.5 Climate Change

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 may increase peak rainfall intensity and river flow, which could result in more frequent and severe flood events. 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.

Recommended contingency allowances for net sea level rises, and recommended national precautionary sensitivity ranges for peak rainfall intensity, peak river flow, offshore wind speed and wave height suitable for use in the planning system are derived from Department for Environment, Food and Rural Affairs FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate Change Impacts, October 2006[27] and presented in Table 3-3 and Table 3-4. It should be noted that these values are subject to change in accordance with data from UKCP09. However at the time of preparation, the best available information has been used for this Level 1 SFRA.

Table 3-3 Recommended contingency allowances for net sea level rises

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
	(Net sea level rise (mm per year) relative to 1990)			
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0

[27] This document has now been superseded by Environment Agency Adapting to Climate Change: Advice for flood and coastal erosion risk management authorities, July 2011, but the allowances are considered suitable for use in the planning system. Further information can be found on the Environment Agency standing advice pages here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296964/LIT_8496_5306da.pdf

Table 3-4 Recommended national precautionary sensitivity ranges for peak rainfall intensity, peak river flow, offshore wind speed and wave height

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

As part of the hydraulic modelling studies for the River Wandle and Beverley Brook, simulations have been run for the 1% annual probability (1 in 100 year event) including the implications of climate change based on these allowances (i.e. 20% increase in river flow). It should be noted that whilst the modelling of the annual probability events to generate the NPPF flood zones (and Flood Map for Planning) do not account for the presence of flood defences, the simulations including an allowance for climate change typically tend to include the presence of existing flood defences.

The flood outline for the 1% AEP (1 in 100 year) event including allowance for climate change and the presence of defences has been mapped for the River Wandle and Beverley Brook in **Appendix A Figure 2.1, Figure 3.1, Figure 4.1 and Figure 5.1.**

It is recommended that the SFRA and other flood risk documents and/or plans for each borough are reviewed following any future publications of new climate change allowances.

3.2.6 Flood defences

Flood defences are structures which affect flow in times of flooding in order to reduce the risk water entering property. They generally fall into one of two categories; 'formal' or 'informal'.

A 'formal' flood defence is a structure which has been specifically built to control floodwater. It is maintained by its owner or statutory undertaker so that it remains in the necessary condition to function. In accordance with the Flood and Water Management Act, the Environment Agency has powers to construct and maintain defences to help against flooding.

An 'informal' defence is a structure that has not necessarily been built to control floodwater and is not maintained for this purpose. This includes road and rail embankments and other linear infrastructure (buildings and boundary walls) which may act as water retaining structures or create enclosures to form flood storage areas in addition to their primary function.

A study of informal flood defences has not been made as part of this assessment. Should any changes be planned in the vicinity of road or railway crossings over rivers in the study area it would be necessary to assess the potential impact on flood risk to ensure that flooding is not made worse either upstream or downstream. Smaller scale informal flood defences should be identified as part of site specific FRAs and the residual risk of their failure assessed.

In accordance with the scope of a Level 1 SFRA, a high level review of formal flood defences has been carried out using data from the Environment Agency Asset Information Management System (AIMS). This dataset contains details of flood defence assets associated with main rivers and provides a good starting point for identifying significant local defences and potential areas benefiting from defences, but the quantity and quality of information provided differs considerably between structures. The AIMS is intended to provide a reasonable indication of the condition of an asset and should not be considered to contain consistently detailed and accurate data (this would be undertaken as part of a Level 2 SFRA or site specific FRA where the need arises).

Flood defences in the study area are presented in the inset maps accompanying **Appendix A Figure 2.1, Figure 3.1, Figure 4.1 and Figure 5.1.**

3.2.7 Tidal Breach Modelling

The River Thames forms the northern boundary of the study area. This area is protected by the presence of the Thames Tidal Defences (TTD), comprising raised defences along the Thames frontage as well as the operation of the Thames Barrier further downstream. This area is therefore at residual risk of tidal flooding associated with the River Thames in the event of a failure or overtopping of the existing defences.

In March 2015, the Thames Tidal Breach Modelling Study[28] was completed for the Environment Agency. The purpose of this Study was to simulate a series of breach scenarios along the Thames frontage, to quantify the residual risk of tidal flooding. In total, 113 breach locations were modelled as part of this study. The results from 12 of these breach locations are of relevance to London Borough of Wandsworth and have been used to inform the assessment of tidal flood risk in Section 7.2.4. Flood hazard results are presented in **Appendix A Figure 5.7, Figure 5.8 and Figure 5.9**.

3.2.8 Flood Warning Areas

The Environment Agency provides a free Flood Warning Service[29] for many areas at risk of flooding from rivers and the sea. In some parts of England the Environment Agency may be able to provide warnings when flooding from groundwater is possible. The Environment Agency has provided a GIS layer of Flood Warning Areas in the study area which are presented in **Appendix A Figure 2.6, Figure 3.6, Figure 4.6 and Figure 5.6**.

3.2.9 Emergency Rest Centres

Each of the London Boroughs has provided details of the emergency rest centres within their administrative areas which are designated in the Multi-Agency Flood Plan. These are presented in **Appendix A Figure 2.1, Figure 3.1, Figure 4.1, and Figure 5.1**.

3.3 Flooding from Surface Water

Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. The PPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of the surface water flood risk published by the Environment Agency as well other available information.

3.3.1 Historic Records of Surface Water Flooding

Historic flooding records from local residents and businesses, Network Rail, Transport for London and the Environment Agency have been gathered by each of the London Boroughs as part of the preparation of the PFRA, SWMP and the LFRMS. These records have been obtained and used to inform this Level 1 SFRA Where possible, the source of the flooding has been identified. Records of flooding which are reported to be from a surface water source are presented in **Appendix A Figure 2.2, Figure 3.2, Figure 4.2 and Figure 5.2**.

3.3.2 Updated Flood Map for Surface Water

The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three annual probability events: 1 in 30 year (3.33% annual probability), 1 in 100 year (1% annual probability) and 1 in 1,000 year (0.1% annual probability). The latest version of the mapping is referred to as the 'updated Flood Map for Surface Water' (uFMfSW) and the extents have been made available for the Level 1 SFRA as GIS layers. This dataset is also available on the Environment Agency website, and is referred to as 'Risk of Flooding from Surface Water'.

The uFMfSW provides all relevant stakeholders, such as the Environment Agency, LPAs and the public access to information on surface water flood risk which is consistent across England and Wales[30]. The modelling helps the Environment Agency take a strategic overview of flooding, and assists LLFAs in their duties relating to management of surface water flood risk. For the purposes of this SFRA, the mapping allows an improved understanding of areas within the study area which may have a surface water flood risk.

The modelling represents a significant improvement on previous mapping, namely the FMfSW (2010) and the Areas Susceptible to Surface Water Flooding (AStSWF) (2009), for example:

- Increased model resolution to 2m grid,
- Representation of buildings and flow routes along roads and manual editing of the model for structural features such as flyovers,
- Use of a range of storm scenarios, and
- Incorporation of appropriate local mapping, knowledge and flood incident records.

However, it should be noted that this national mapping has the following limitations:

[28] CH2MHill, March 2015, Thames Tidal Breach Modelling Study.
[29] Environment Agency Flood Warning Service http://apps.environment-agency.gov.uk/wiyby/37835.aspx
[30] Environment Agency (2013) 'What is the updated Flood Map for Surface Water?'

- Use of a single drainage rate for all urban areas,
- It does not show the susceptibility of individual properties to surface water flooding,
- The mapping has significant limitations for use in flat catchments,
- No explicit modelling of the interaction between the surface water network, the sewer systems and watercourses,
- In a number of areas, modelling has not been validated due to a lack of surface water flood records, and
- As with all models, the uFMfSW is affected by a lack of, or inaccuracies, in available data.

The uFMfSW for the study area is presented in **Appendix A Figure 2.2 (Croydon), Figure 3.2 (Merton), Figure 4.2 (Sutton) and Figure 5.2 (Wandsworth)** in combination with historical surface water flooding data recorded by the Environment Agency and each of the London Borough Councils.

3.3.3 Climate Change

The uFMfSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However a range of three annual probability events have been undertaken, 3.3%, 1% and 0.1% and therefore it is considered appropriate to use the 0.1% AEP event as a substitute dataset to provide a worst case scenario and an indication of the implications of climate change.

3.3.4 Drainage Catchments

As part of the Level 1 SFRA, Drainage Catchments (DCs) have been determined across the study area. Drainage catchments outline the area of the land that influences the surface water drainage at a certain point. The scale of a drainage catchment varies depending on the point of interest. The extent of a natural drainage catchment follows peaks in the local topography that surface water will drain from. The DCs determined in this study are based on the natural catchments and watersheds that cover the four boroughs, which are provided within the Flood Estimation Handbook CD-ROM and have then been amended using local knowledge to account for significant infrastructure within the study area that could impact on drainage such as railway lines.

Using this method, 56 DCs were identified covering the whole study area. In some cases the DCs cross the Borough boundaries. Therefore, of the 56 DCs, 19 catchments cover the London Borough of Croydon, 17 catchments cover the London Borough of Sutton, 19 cover the London Borough of Merton and 20 cover the London Borough of Wandsworth.

It is intended that these DCs will be useful for identifying the natural drainage patterns in the local area when considering new development and future regeneration in the study area. The potential for implementing new approaches and requirements for surface water management can be considered by each of the London Boroughs within the context of specific DCs. For example, local topography could be used to determine flow paths within each DC, which could highlight potential areas to focus surface water management techniques.

The DCs for each Borough are shown in **Appendix A Figures 2.3 (Croydon), 3.3 (Merton), 4.3 (Sutton) and 5.3 (Wandsworth)**.

3.3.5 Critical Drainage Areas (CDAs)

The Environment Agency refers to a Critical Drainage Area (CDA) as an area within Flood Zone 1 which has 'critical drainage issues'. However, within the SWMPs for each of the London Boroughs, CDAs were delineated based on the following 'working definition': 'a discrete geographic area (usually within an urban setting) where there may be multiple and interlinked sources of flood risk and where severe weather is known to cause flooding of the area thereby affecting people, property or local infrastructure'. Therefore the CDAs for the London Boroughs are not restricted to Flood Zone 1.

Using this definition, 52 CDAs were delineated across the study area and presented within the SWMPs. These CDAs are used by each of the London Boroughs in the management of local flood risk and the consideration and prioritisation of potential flood mitigation and management options.

3.4 Flooding from Groundwater

Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground.

3.4.1 Historic Records

Over the last few years, information on historical flooding in the study area has been gathered by each of the London Boroughs in accordance with their duties as LLFAs, and as part of the preparation of the PFRA, SWMP and most recently the LFRMS. Where possible, the source of the flooding has been identified. Records of flooding which are reported to be from a groundwater source are presented in **Appendix A Figure 2.3 (Croydon), Figure 3.3 (Merton), Figure 4.3 (Sutton) and Figure 5.3 (Wandsworth)**. It should be noted that there has not been a statutory obligation to record incidences of groundwater flooding in the past and therefore it is likely that the groundwater flooding incidents recorded are not exhaustive.

3.4.2 SWMP Groundwater Flooding Assessment

As part of the SWMPs for each of the London Boroughs prepared under the Drain London Project, an assessment of the risk of groundwater flooding was undertaken. Areas where there is increased potential for groundwater levels to rise within 2m of ground surface, following periods of higher than average recharge, were identified and separated into permeable superficial deposits and bedrock (consolidated) aquifers. The dataset was produced for the whole of the Drain London project area, derived from four individual data sources available at the time; British Geological Survey (BGS) Groundwater Flood Susceptibility maps; Environment Agency (EA) Thames Estuary 2100 groundwater hazard maps; Jacobs Groundwater emergence maps; and JBA Groundwater flood maps. Subsequent to the preparation of the SWMPs, the BGS have made available a further dataset, described further below.

3.4.3 Susceptibility to Groundwater Flooding

In response to the need for more information on groundwater flooding, BGS has produced the first national dataset on the susceptibility of groundwater flooding. Based on geological and hydrogeological information, the digital data can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. Note, it is a susceptibility set, it does not indicate hazard or risk, i.e. it does not provide any information on the depth to which groundwater flooding occurs or the likelihood of the occurrence of an event of a particular magnitude.

The 'Susceptibility to Groundwater Flooding' dataset is divided into three classes – High, Medium and Low risk as follows:

- High – areas with the potential for groundwater flooding to occur at the surface;
- Medium – areas which may experience groundwater flooding of property situated below the ground surface i.e. basements;
- Low – areas with limited potential for groundwater flooding to occur.

The BGS state that the dataset is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

This dataset has been mapped in **Appendix A Figure 2.5 (Croydon), Figure 3.5 (Merton), Figure 4.5 (Sutton) and Figure 5.5 (Wandsworth)**.

3.5 Flooding from Sewers

During heavy rainfall, flooding from the sewer system may occur if:

(1) The rainfall event exceeds the capacity of the sewer system/drainage system:

Sewer systems are typically designed and constructed to accommodate rainfall events with a 3.3% AEP or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. While TWUL, as the sewerage undertaker for the study area, recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.

(2) The system becomes blocked by debris, sediment or fat:

Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter). Fat build up within the main sewer system is also a contributing factor of sewer flooding.

(3) The system surcharges due to high water levels in receiving watercourses:

Within the study area there is potential for surface water outlets to become submerged due to high river levels. When this happens, water is unable to discharge. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses. Where the local area is served by 'combined' sewers i.e. containing both foul and storm water, if rainfall entering the sewer exceeds the capacity of the combined sewer and storm overflows are blocked by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance floodwaters will contain untreated sewage.

3.5.1 Historic Records

TWUL has provided an extract from their DG5 Flood Register for the study area, which records historic internal and external sewer flooding events. Due to data protection requirements the data has not been provided at individual property level; rather the register comprises the number of properties within four digit postcode areas that have experienced flooding either internally or externally within the last 10 years.

It should be noted that records only appear on the DG5 register where they have been reported to TWUL, and as such they may not include all instances of sewer flooding. Furthermore given that TWUL target these areas for maintenance and improvements, areas that experienced flooding in the past may no longer be at greatest risk of flooding in the future.

The DG5 Register of internal and external property flooding, as well as historic records of sewer flooding held by each of the London Borough Councils have been presented in **Appendix A Figures 2.5 (Croydon), 3.5 (Merton), 4.5 (Sutton) and 5.5 (Wandsworth)**.

3.5.2 Consulting with Thames Water Utilities Ltd

The boroughs have consulted with Thames Water for each allocated site within their Local Plan to identify areas with potential sewer capacity issues, as follows:

- London Borough of Croydon, London Borough of Sutton and London Borough of Wandsworth have consulted with Thames Water on sewer capacity for each site allocation in their Local Plan.

- As part of their Sites Allocation process, London Borough of Merton consulted with Thames Water at varies stages of consultations towards adoption and received comments for each Site Allocations from Thames Water. The comments received from Thames Water informed and influence the Site Allocation site use. Thames Water comments can be viewed on Merton Council's website and the Sites and Policies Plan. Merton Council in accordance with planning policy DM F2 requires developers to demonstrate that when discharging water, including into the public sewer, the local sewer network has adequate capacity to serve the development and existing developments. If the public sewer does not have adequate capacity, the developer should demonstrate alternative sustainable approaches to the management of water.

3.6 Flooding from Reservoirs, Canals and Other Artificial Sources

3.6.1 Risk of Flooding from Reservoirs

The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The NPPG encourages LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding.

The Environment Agency dataset 'Risk of Flooding from Reservoirs' available online identifies areas that could be flooded if a large[31] reservoir were to fail and release the water it holds. The mapping has been used to identify the risk across the study area.

Reservoirs in the UK have an extremely good safety record. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir

[31] A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools.

panel engineers. It is assumed that these reservoirs are regularly inspected and essential safety work is carried out. These reservoirs therefore present a managed risk.

Each London Borough is responsible for working with members of the Local Resilience Forum (LRF) to develop emergency plans for reservoir flooding and ensuring communities are well prepared.

3.7 Summary

This Section has provided an overview of the methodology and datasets used to inform the Level 1 SFRA. The following Sections form the Level 1 SFRA for each of the London Boroughs as follows:

Section 4 – Flood Risk in the London Borough of **Croydon**

Section 5 – Flood Risk in the London Borough of **Merton**

Section 6 – Flood Risk in the London Borough of **Sutton**

Section 7 – Flood Risk in the London Borough of **Wandsworth**.

4 Flood Risk in the London Borough of Croydon

4.1 Overview

This Section provides the strategic assessment of flood risk across the **London Borough of Croydon** from each of the sources of flooding outlined in the NPPF. For each source of flooding, details of any historical incidents are provided, and where appropriate, the impact of climate change on the source of flooding is described. This Section should be read with reference to the figures in Appendix A.

4.2 Flooding from Rivers

4.2.1 Flood Zones

The majority of London Borough of Croydon (97.8%) is defined as Flood Zone 1 Low Probability of flooding from rivers. Approximately 1.7% is defined as Flood Zone 2 Medium Probability, and less than 0.5% is defined as Flood Zone 3a High Probability and Flood Zone 3b Functional Floodplain respectively.

The River Wandle rises from natural springs at Waddon Ponds immediately west of Croydon town centre. It has recently been de-culverted to flow in an open section through Wandle Park before it is culverted again and flows west into the London Borough of Sutton. Flood zone mapping included in **Appendix A Figure 2.1** shows that Flood Zone 3a associated with the River Wandle extends across the western part of Wandle Park and the industrial area up to Factory Lane. Flood Zone 2 extends further to the north and west across the A23 Purley Way and up the borough boundary. The open channel section of the River Wandle through Wandle Park is designated Flood Zone 3b Functional Floodplain.

Appendix A Figure 2.1 shows that the Norbury Brook begins in Selhurst as an ordinary watercourse which flows in open channel through Heavers Meadow and is then culverted beneath Selhurst Road and Whitehorse Road. It then becomes a main river and flows in open channel northwest through residential area of Thornton Heath and the Recreation Ground, beneath the railway line and into Norbury Park. The floodplain associated with the Norbury Brook is approximately 100m wide along the majority of its open channel sections. Areas within the Recreation Ground and Norbury Park are designated Flood Zone 3b Functional Floodplain. Upon leaving Norbury Park the Norbury Brook flows north into London Borough of Lambeth and becomes the River Graveney, which itself is a tributary of the River Wandle further down the catchment.

The Caterham Bourne is an ephemeral watercourse which is believed to flow approximately every 7 years. The watercourse rises in Caterham in Surrey and flows northwest in and out of culvert through Whyteleafe, Kenley and Riddlesdown. It then becomes culverted and is designated as a surface water sewer which continues towards Purley. At Purley Cross the sewer passes north beneath the A23 Brighton Road and the A236 before discharging to the River Wandle at Wandle Park. **Appendix A Figure 2.1** shows that the floodplain associated with the Caterham Bourne in the south east of the borough is approximately 30m wide, increasing to approximately 100m wide along the Brighton Road.

The Chaffinch Brook is located in the north east of the Borough. It flows north east close to the boundary with the London Borough of Bromley, eventually joining the Pool River and River Ravensbourne. There is a small portion of Flood Zone 2 and 3 in this part of the Borough, primarily associated with parkland areas.

4.2.2 Functional Floodplain

London Borough of Croydon Council have used the modelled outlines for the 5% AEP event for the River Wandle and Norbury Brook to define the Functional Floodplain (Flood Zone 3b) associated with these watercourses, as shown in **Appendix A Figure 2.1**. These areas are chiefly undeveloped areas within Wandle Park, Norbury Park and the Recreation Ground adjacent to Melfort Road.

4.2.3 Historic Records

Significant flood events associated with the Caterham Bourne have occurred within recent memory. During January to March 2014, and throughout the winter of 2000-2001, disruption lasted over several months. The high groundwater levels that were experienced during these events resulted in floodwaters receding very slowly. There are also records of a number of similarly damaging floods during the 20th century, when the Bourne was in flow.

The London Borough of Croydon LFRMS[32] notes that historic flood records dating back to the 1960s indicate numerous incidents associated with the Norbury Brook as a result of overtopping in open sections as well as surcharging of manholes and culverts in its culverted sections.

The Environment Agency Historic Flood Map does not provide many records of fluvial flooding in Croydon. There is a small extent associated with the Chaffinch Brook at Elmers End, although this is more significant across the borough boundary in London Borough of Bromley.

Within the historic records supplied by London Borough of Croydon, none are identified as fluvial flooding. However it should be noted that there are numerous records of flooding along the Brighton Road, which is located in the topographic depression along the route of a former watercourse. The source of these events are typically recorded as surface water or sewer flooding rather than fluvial flooding, as the watercourse has been culverted and can no longer be seen.

4.2.4 Climate Change

Appendix A Figure 2.1 includes the modelled outline for the River Wandle for the 1% AEP event including an allowance for climate change. As described in Section 3.2.5, this is generated by considering an increase in peak flow as a result of the anticipated effects of climate change. These modelled scenarios also include the presence of flood defences along the watercourses. The results show a minimal increase in the flood outline north of Wandle Park. Modelled scenarios including the impacts of climate change are not available for the Norbury Brook or Caterham Bourne watercourses.

4.2.5 Ordinary Watercourses

According to Environment Agency records, the mapped ordinary watercourses in Croydon include the upstream section of the Norbury Brook, near Selhurst in the north of the Borough, and the tip of the Beck, which flows into the London Borough of Bromley. A number of other watercourses have been identified, including ephemeral bournes, which only flow when the groundwater is high. The London Borough of Croydon LFRMS[32] identifies the requirement for these watercourses to be mapped and riparian responsibilities clarified to aid future management.

Within Croydon, significant lengths of ordinary watercourse are culverted, with trash screens often located on the upstream end of culverts. Trash screens and culverts have the potential to become blocked by items such as plant debris and rubbish. Blockages can restrict the natural flow of water, increasing the chance of water flowing out of bank and causing local flooding due to the reduced conveyance potential of the associated watercourse. Further asset information and actions in place to address their risk to flooding are available in the London Borough of Croydon LFRMS[32] and Action Plan.

Croydon Council is aware of flooding problems associated with ordinary watercourses. The Merstham Bourne, an ephemeral watercourse which has an open section near Coulsdon South Station, caused flooding to residents' gardens during the wet weather of winter 2014, as did the drainage ditch running behind Wharfedale Gardens in Norbury. A number of problems have been noted with flooding at Heavers Meadow allotments, which sit alongside the Norbury Brook in an open section where it is an ordinary watercourse. Numerous other open ditches and streams around the borough can cause problems where trash screens or downstream culverts get blocked. Problems associated with a drainage ditch in Park Hill Park in recent years have led to flooding threatening the main London to Brighton railway line. These issues have been exacerbated by a blockage in the downstream culvert and a burst water main in addition to local geography and capacity of the ditch itself.

4.2.6 Flood Defences

The Environment Agency Flood Map for Planning does not identify any formal flood defences along the main river watercourses in Croydon.

Extracts from the Environment Agency Asset Information Management System (AIMS) provided to inform the Level 1 SFRA show that the short section of the River Wandle that stretches from Purley Way to the boundary with London Borough of Sutton is culverted in a 3m culvert maintained by the local authority. The section within Wandle Park has since been de-culverted and is now in open channel.

The AIMS identifies that the Norbury Brook flows through a concrete lined channel which is privately maintained. Concrete walls are present on both banks along sections of the watercourse. The watercourse is culverted in three locations, beneath Selhurst Road and Whitehorse Road, beneath the railway line adjacent to Norbury Park, and beneath the A23 at the borough boundary with London Borough of Lambeth.

[32] Croydon Council. Capita URS, June 2014, London Borough of Croydon Local Flood Risk Management Strategy, Draft for consultation.

The AIMS dataset is shown in **Appendix A Figure 2.1 Inset Maps.**

4.2.7 Flood Warning Areas

There are three Environment Agency Flood Warning Areas in Croydon, identified in **Appendix A Figure 2.6**, as follows:

- River Wandle at Beddington Park
- Norbury Brook at Thornton Heath and Streatham Vale
- Chaffinch Brook and St James Stream at Elmers End and Upper Elmers End.

4.2.8 Emergency Rest Centres

Emergency rest centres designated by London Borough of Croydon are mapped in **Appendix A Figure 2.1** and summarised in Table 4-1.

Table 4-1 Emergency Rest Centres in London Borough of Croydon

ID	Address	Easting	Northing
1	Sanderstead Methodist Church, Limpsfield Road, South Croydon, Croydon, CR2 9DA	534265	160599
2	South Croydon United Church Hall, Heathfield Road, Croydon, CR0 1ES	532528	164644
3	United Reformed Church, Sanderstead Hill, South Croydon, Croydon, CR2 0HB	533475	161903
4	Kenley Memorial Hall, 92 Godstone Road, Kenley, Croydon, CR8 5AB	532522	160164
5	The Salvation Army, Booth Road, Croydon, CR0 1XY	531840	165536
6	Salvation Army Hall, Hares Bank, Croydon, CR0 0ET	538829	162076
7	66 High Street, Thornton Heath, Croydon, CR7 8LF	532611	168371
8	The Salvation Army, Westow Street, Upper Norwood, London, Croydon, SE19 3AF	533464	170457
10	East Croydon United Reform Church, Addiscombe Grove, Croydon, CR0 5LP	533071	165637
11	89 Whitehorse Road, Croydon, CR0 2JJ	532501	166968

4.3 Flooding from Surface Water

4.3.1 Historic Records

London Borough of Croydon has experienced a number of surface water flood events, the most notable of which was the 20th July 2007, where intense periods of rainfall caused flash floods and the capacity of the existing drainage system to be exceeded in numerous locations across the borough. Purley town centre experienced some of the worst flooding with significant flooding to property and the transport network.

The PFRA and SWMP identify parts of Croydon to be particularly susceptible to surface water flooding, including Brighton Road through Purley up to Central Croydon and the A22 Godstone Road. 420 records of surface water flooding have been provided by the Council and mapped in **Appendix A Figure 2.2.** Specific episodes of surface water flooding are recorded in the following locations:

- Purley Cross roundabout and Brighton Road
- Kenley Lane and Kenley Station
- Brighton Road, Coulsdon
- Hamsey Green
- Purley Oaks Road and station
- Norbury and Thornton Heath

Within the SWMP 16 CDAs are defined in London of Croydon, as presented in Table 4-2.

Table 4-2 SWMP CDAs in London Borough of Croydon

CDA ID	CDA Name
Group8_034	Woodplace Lane
Group8_035	Marlpit Lane
Group8_036	Old Lodge Lane
Group8_037	Kenley Station
Group8_038	Downs Court Road
Group8_039	Chipstead Valley Rd
Group8_040	Purley Cross
Group8_041	Brighton Rd
Group8_042	South & Central Croydon
Group8_043	Carlton Road & Industrial Estate
Group8_044	Croham Road
Group8_045	Forestdale/Addington
Group8_046	Woodside
Group8_047	South Norwood
Group8_048	South Norwood Hill
Group8_049	Norbury

4.3.2 Updated Flood Map for Surface Water

The updated Flood Map for Surface Water (uFMfSW) presented in **Appendix A Figure 2.2** supports many of the records of flooding and illustrates how surface water follows the natural topography of the land and accumulates in the natural depressions created by ditches, streams and tributaries of the primary watercourses.

As part of the Level 1 SFRA, Drainage Catchments (DCs) have been determined across the London Borough of Croydon in order to better understand and manage the risk from surface water flooding. Drainage catchments outline the area of the land that influences the surface water drainage at a certain point. The DCs are based on the natural catchments and watersheds provided within the Flood Estimation Handbook CD-ROM which have then been amended using local knowledge to account for significant infrastructure within the study area that could impact on drainage such as railway lines. It is intended that these DCs will be useful for identifying the natural drainage patterns in the local area when considering new development and future regeneration in the study area.

19 Drainage Catchments (DC) have been identified in London Borough of Croydon, as shown in **Appendix A Figure 2.3**. The majority of the Drainage Catchments in the south of the Borough form part of the River Wandle catchment. The Drainage Catchments in the north of the Borough drain into the Norbury Brook. Along the north eastern edge of the Borough, the topography slopes towards London Borough of Bromley, and these Drainage Catchments drain towards the River Ravensbourne.

4.4 Flooding from Groundwater

4.4.1 Historic Records

The Council have 37 records of groundwater flooding in the Borough which are shown in **Appendix A Figure 2.4**. Instances of groundwater flooding have been reported in a number of areas in Croydon with some regular hotspots in the north of the Borough.



Figure 4-1 Firefighters in Dale Road, Purley during flooding associated with the Caterham Bourne, February 2014
(source: Croydonguardian.co.uk)

The most high profile and widespread floods influenced by high groundwater have been associated with the Caterham Bourne in the south of the Borough, which caused significant disruption in the winter of 2000-2001 and more recently in early 2014, threatening significant numbers of homes, essential infrastructure and transport networks.

4.4.2 Susceptibility to Groundwater Flooding

The Susceptibility to Groundwater Flooding dataset provided by the BGS can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

The Borough of Croydon is divided into two distinct areas with respect to bedrock geology. The north of the Borough is underlain by impermeable London Clay, whereas the south is underlain by permeable chalk. River terrace deposits are present along the river corridors throughout the Borough. The Susceptibility to Groundwater Flooding dataset presented in **Appendix A Figure 2.4** indicates that there is potential for groundwater flooding to occur at the surface along the route of the watercourses where the permeable river terrace deposits are present and are providing potential pathways for water during periods of elevated groundwater levels in the chalk aquifer.

4.5 Flooding from Sewers

4.5.1 Historic Records

TWUL and London Borough of Croydon have supplied records of sewer flooding for the Borough which are presented in **Appendix A Figure 2.5**. These indicate that incidents of sewer flooding have occurred throughout the Borough and are not limited to specific areas.

The LFRMS for Croydon identifies that numerous incidents in the historic flood register are attributed to surcharging sewers although evidence is anecdotal and it is not always clarified whether highway drainage or culverted watercourses have influenced the incident. A number of incidents are recorded in Thornton Heath and Broad Green in close proximity to the Norbury Brook as well as known surface water hotspots in Coulsdon.

4.5.2 Climate Change

Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events. However as the majority of Croydon is served by separate foul and surface water sewers the risk from sewer flooding in the London Borough of Croydon is considered to be low.

TWUL continue to monitor the risk of sewer flooding and put plans in place to manage the risk, as required, based on their business plan and priorities. Croydon Council will work with TWUL to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated. TWUL prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company.

4.6 Flooding from Other Sources

4.6.1 Risk of Flooding from Reservoirs

There have been no recorded incidents of reservoir flooding within London Borough of Croydon. The Environment Agency Flood Risk from Reservoirs mapping available online identifies that if the Russell Hill Reservoir were to fail it would impact areas of West Croydon and Waddon although impact would be greater in London Borough of Sutton to the West including Wallington and Hackbridge around the route of the River Wandle. If South Norwood Lake were to fail then the impact would be almost entirely within London Borough of Bromley, affecting areas of Penge, Beckenham and Lower Sydenham.

Table 4-3 Areas at risk of flooding from reservoirs

Name	Owner	Local Authority	Grid Ref	Areas affected
Russell Hill	Thames Water Utilities Ltd	Croydon	531451, 162811	From Roundshaw Park northwards along the A23 towards Stafford Road and Waddon railway station. Veers west and branches following the course of the River Wandle towards Beddington and Hackbridge.
South Norwood Lake	London Borough of Croydon Council	Croydon	534189, 169419	Penge, Beckenham and Lower Sydenham (within London Borough of Bromley).

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers on a yearly basis. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency are responsible for ensuring that reservoirs are inspected regularly and essential safety work is carried out. As the undertaker for South Norwood Lake, Croydon Council is required to ensure that inspections are carried out by a qualified panel engineer and that necessary safety work is completed as required to reduce the likelihood of any failure.

4.7 Summary of Flood Risk in London Borough of Croydon

Table 4-4 provides a summary of the number of residential, non-residential and unclassified properties within each flood zone, and Table 4-5 provides a summary of the number of properties which intersect with the Low, Medium and High designations within the uFMfSW. The property counts have been provided by Drainage Catchment (as shown in **Appendix A Figure 2.3**).

Table 4-4 Properties at risk of fluvial flooding in London Borough of Croydon by Drainage Catchment

Drainage Catchment	Flood Zone 1			Flood Zone 2			Flood Zone 3a			Flood Zone 3b		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC20	3,678	238	193	0	0	0	0	0	0	0	0	0
DC21	2,943	35	171	0	0	0	0	0	0	0	0	0
DC22	43,858	1,766	1,970	640	7	12	770	20	38	235	48	15
DC23	2053	11	76	0	0	0	0	0	0	0	0	0
DC37	4315	331	441	0	0	0	0	0	0	0	0	0
DC38	11,166	665	576	3	70	64	0	3	15	0	0	0
DC39	17,561	1,544	1,493	268	32	24	2,480	322	207	0	0	0
DC40	18,385	552	977	27	0	0	168	2	13	0	0	0
DC41	1397	56	67	48	1	4	0	0	0	0	0	0
DC42	13,360	265	733	0	0	0	0	0	0	0	0	0
DC43	3,223	145	133	0	0	0	0	0	0	0	0	0
DC44	3,020	34	182	0	0	0	0	0	0	0	0	0
DC45	2,492	121	115	0	0	0	0	0	0	0	0	0
DC46	4,316	74	277	1	0	0	35	0	4	0	0	0
DC47	1,278	29	300	0	0	0	0	0	0	0	0	0
DC53	453	7	81	0	0	0	0	0	0	0	0	0
DC54	2,349	101	173	0	0	0	0	0	0	0	0	0
DC55	4,273	95	315	0	0	0	0	0	0	0	0	0
DC56	4,020	80	376	43	3	3	460	33	49	0	0	0
TOTAL	**144,140**	**6,149**	**8,649**	**1,030**	**113**	**107**	**3,913**	**380**	**326**	**235**	**48**	**15**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the Flood Zones. Where properties intersect two Flood Zones, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [1]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[1] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

Table 4-5 Properties at risk of surface water flooding in London Borough of Croydon by Drainage Catchment

Drainage Catchment	uFMfSW Low			uFMfSW Medium			uFMfSW High		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC20	691	22	28	221	7	12	158	4	8
DC21	629	3	28	245	4	5	79	9	1
DC22	9,977	461	410	2,731	124	118	1,132	131	93
DC23	322	2	18	41	0	5	16	0	0
DC37	771	57	101	291	40	25	101	106	31
DC38	2,654	156	155	519	75	35	123	26	13
DC39	5,106	394	396	2,669	454	231	1,998	278	159
DC40	3,811	131	205	1,220	61	62	568	28	56
DC41	176	35	12	79	1	3	36	1	3
DC42	2,701	50	104	726	29	42	594	25	47
DC43	484	28	21	134	21	6	27	6	0
DC44	574	5	14	141	5	10	118	3	6
DC45	601	5	15	117	5	7	131	66	1
DC46	899	11	29	247	0	13	223	7	19
DC47	223	9	47	117	1	8	93	7	10
DC53	49	2	6	15	2	2	49	0	1
DC54	496	15	25	93	21	13	21	11	8
DC55	810	17	40	194	2	7	132	1	5
DC56	1,116	31	68	294	19	34	257	28	52
TOTAL	**32,090**	**1,434**	**1,722**	**10,094**	**871**	**638**	**5,856**	**737**	**513**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the categories within the uFMfSW. Where properties intersect two or three categories from the uFMfSW, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [2]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[2] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

5 Flood Risk in the London Borough of Merton

5.1 Overview

This Section provides the strategic assessment of flood risk across the **London Borough of Merton** from each of the sources of flooding outlined in the NPPF. For each source of flooding, details of any historical incidents are provided, and where appropriate, the impact of climate change on the source of flooding is described. This Section should be read with reference to the figures in Appendix A.

5.2 Flooding from Rivers

5.2.1 Flood Zones

Approximately 91% of the London Borough of Merton is defined as Flood Zone 1 Low Probability of flooding from rivers. 5.2% is defined as Flood Zone 2 Medium Probability, 1.9% as Flood Zone 3a High Probability, and 1.7% as Flood Zone 3b Functional Floodplain.

The River Wandle flows in a roughly south-east to north-west direction through the borough. **Appendix A Figure 3.1** identifies areas of Flood Zone 2 and 3 associated with the River Wandle including properties around the Eagle Trading Estate in the south of the borough; Watermeads Nature Reserve, Ravensbury Park and Morden Hall Park; properties between Ravensbury Park and Morden Hall Park; areas around Brangwyn Crescent and to the west of Merantun Way; a number of properties along Runnymead and Liberty Avenue and Homefield Gardens; Wandle Park and Wandle Meadow Nature Park in Colliers Wood; Wimbledon Stadium and properties located to the south; and properties in the north-east of the Borough surrounding Brooklands Avenue.

The River Graveney is a tributary of the River Wandle. The watercourse originates as the Norbury Brook, before becoming the River Graveney to the east of Merton. The River Graveney flows in an approximately east to west direction along the northern boundary of Merton. **Appendix A Figure 3.1** identifies the area to the north east of Mitcham Eastfields railway station to be defined as Flood Zone 2 associated with the River Graveney, extending towards Oakleigh Way Recreation Ground and the northern part of Figge's Marsh.

The Beverley Brook flows in an approximately south-north direction along the western boundary of Merton and eventually discharges into the River Thames at Barnes. **Appendix A Figure 3.1** shows areas of Flood Zone 3 in Beverley Park, and adjacent to Aboyne Drive, and areas of Flood Zone 2 in Beverley Meads Recreation Ground and Fishponds Wood Nature Reserve.

The Pyl Brook is a tributary of the Beverley Brook. The Pyl Brook rises to the south of Sutton Common train station before flowing in an approximately south-east to northwest direction through Merton and connecting to the Beverley Brook in Beverley Park on the western boundary of Merton. An approximately 600m section of the Pyl Brook running adjacent to West Barnes Lane is culverted between Kingsway and Raynes Park High School. The Derwent Road Flood Storage Area provides additional storage from the Pyl Brook during periods of high flow. Areas surrounding Raynes Park High School, Memorial Ground, Westway and West Barnes Lane are defined as Flood Zone 3 associated with the Pyl Brook. Areas surrounding Cannon Hill Lane and Lower Morden Road are defined as Flood Zone 2.

5.2.2 Functional Floodplain

Modelled outlines for the 5% AEP event, including the presence of flood defences, for the River Wandle and Beverley Brook have been used by London Borough of Merton as the starting point to define Functional Floodplain associated with these watercourses. The following criteria have then been applied to remove selected buildings from the Functional Floodplain:

- All residential and school buildings removed
- Commercial (i.e. less vulnerable) buildings which have less than 50% coverage of the 5% (1 in 20 year) AEP outline have been removed.

The remaining outline forms Flood Zone 3b Functional Floodplain for London Borough of Merton and has been mapped in **Appendix A Figure 3.1**. In addition, the Flood Storage Area on the Pyl Brook adjacent to the Morden Cemetery has been included in the Flood Zone 3b Functional Floodplain definition.

5.2.3 Historic Records

The Environment Agency Historic Flood Map indicates that extensive flooding occurred in Merton in 1968 in the south west of the Borough around West Barnes, along the banks of the Pyl Brook and the Beverley Brook. Prior to this, flooding occurred in 1937. This flood event affected small areas along the Beverley Brook and relatively small patches of flooding occurred in proximity to Marina Avenue and Burlington Road.

In 2007 extensive flooding occurred as a result of high water levels in the Beverley Brook and Pyl Brook, blocking outfalls and causing water to back up in the road drainage system and flood. This occurred in what is presently Raynes Park High School, along with areas south of Malden Way and down towards West Barnes Lane and along the Pyl Brook from Lower Morden Lane towards Raynes Park High School. Hatfield Primary School experienced flooding of approximately 300mm depth as a result of overtopping of the Pyl Brook and the East Pyl Brook flowed out of bank where it flows through the south-west end of Morden Park up towards Camborne Road. Less extensive flooding associated with the Pyl Brook occurred between Lower Morden Lane and the southern boundary of Merton.

There are two records of fluvial flooding presented in **Appendix A Figure 3.1.** One is thought to be associated with the culverted section of the River Graveney in Colliers Wood. The other is associated with the Pyl Brook adjacent to Lower Morden Lane.

5.2.4 Climate Change

Appendix A Figure 3.1 includes the modelled outline for the 1% AEP event including an allowance for climate change for the River Wandle, River Graveney, Beverley Brook and Pyl Brook. As described in Section 3.2.5, this is generated by considering an increase in peak flow as a result of the anticipated effects of climate change. These modelled scenarios also include the presence of flood defences along the watercourses. The results show a minimal increase in the extent of flooding around Cannon Hill Lane associated with the Pyl Brook. There is no significant increase in flood extent associated with the River Wandle, River Graveney and Beverley Brook.

5.2.5 Ordinary Watercourses

In total there is approximately 69km of ordinary watercourse in Merton, approximately 5km of which is culverted. The majority of watercourses are located in Wimbledon Common, Mitcham Common, Raynes Park, Cannon Hill Common and Wimbledon Park. A number of these are small ditches located in Council managed parks and adjacent to roads.

Trash screens and culverts have the potential to become blocked by items such as plant debris and rubbish. Blockages can restrict the natural flow of water, increasing the chance of water flowing out of bank and causing local flooding due to the reduced flow of the associated watercourse.

Merton Council is aware of a number of areas with known flooding problems associated with ordinary watercourses, including:

- The watercourse adjacent to Meadowsweet Close, which has a history of flooding due to overgrown vegetation and blockage of the trash screen. This can impact the culverted section of watercourse upstream which runs along the rear of the properties along Grand Drive.
- The watercourse flowing through Kings College School Sports Ground in Raynes Park. A section flows eastward, connecting to the Pyl Brook, whilst a section flows westward and is culverted underneath Arthur Road. Flooding has been reported when the culvert and associated trash screen has become blocked.

5.2.6 Flood Defences

Extracts from the Environment Agency Asset Information Management System (AIMS) provided to inform the Level 1 SFRA show that the River Wandle is predominantly defended by high ground along its course. There are culverted sections along Merantun Way and an embankment and flood defence wall along the right bank of the River Wandle adjacent to Waterside Way. The River Graveney is also partially culverted along High Street Colliers Wood.

The Beverley Brook is partially culverted along its course in London Borough of Merton. There is a short length of flood defence wall to the south of the station at Motspur Park. The remainder of its course it is protected by high ground.

The AIMS dataset is shown in **Appendix A Figure 3.1 Inset Maps.**

5.2.7 Flood Warning Areas

There are 10 Environment Agency Flood Warning Areas in London Borough of Merton, identified in **Appendix A Figure 3.6,** as follows:

- Beverley Brook at Wimbledon Common and Richmond Park
- Beverley Brook at Raynes Park
- Beverley Brook at West Barnes
- Pyl Brook at West Barnes
- Pyl Brook at North Cheam
- East Pyl Brook at Morden Park
- River Wandle at Morden
- River Wandle at Wimbledon
- River Wandle at Wandsworth
- River Graveney at Tooting and Colliers Wood

5.2.8 Emergency Rest Centres

Emergency rest centres designated by London Borough of Merton are mapped in **Appendix A Figure 3.1** and summarised in Table 5-1.

Table 5-1 Emergency Rest Centres in London Borough of Merton

Emergency Rest Centre	Address	Easting	Northing
Canons Leisure Centre	Madeira Road CR4 4HD	528004	168342
Christ the King	The Crescent SW19 8AJ	525395	172147
Cottenham Park Pavilion	Melbury Gardens SW19 1LA	525476	170004
Dundonald Park Pavilion	Fairlawn Road SW19 3QH	524690	170139
King George's Pavilion	Tudor Drive SM4 4NP	523564	166946
Kings College School	Southside SW19 4TT	523447	170678
Morden Park Assembly hall	Tudor Drive SM4 4PJ	523872	167108
Morden Baptist church	Crown Lane SM4 5BL	525576	168522
New Horizons,	South Lodge Avenue, Pollards Hill, Mitcham. CR4 1LT	530134	168422
Phipps Bridge Youth centre	Cobham Court, Haslemere Avenue CR4 3PR	526566	169159
Pollards Hill Youth Centre	South Lodge Avenue, CR4 1LT	530134	168422
Raynes Park High School	Bushey Road SW20 0JL	522579	168610
Raynes Park Pavilion	Off Taunton Avenue West Barnes Lane SW20 0BH	522723	169186
Sir Joseph Hood Memorial Playing Fields Pavilion	Marina Avenue KT3 6NE	522744	167553
South Mitcham Community Centre	Cobham Court, Haslemere Avenue CR4 3PR	526566	169159
St Luke's Church hall	Strathmore Road SW19 8BZ	525312	172312
Vestry Hall	336 – 338 London Road CR4 3UD	527522	168602

5.3 Flooding from Surface Water

5.3.1 Historic Records

As shown in Table 5-2, London Borough of Merton has experienced a number of surface water flood events, the most notable of which was on 20th July 2007, when heavy rainfall caused flooding from surface water, rivers and sewers to combine to impact properties across the Borough, particularly within the areas of Raynes Park, West Barnes, Colliers Wood and South Wimbledon.

Table 5-2 – Records of Surface Water Flooding

Flood Event	Description
23rd June 2005 *(Surface Water Flooding)*	Thunderstorms occurred across London, with particularly heavy rain and hail in Wimbledon, resulting in overland flow and flash flooding
20th July 2007 *(Surface Water Flooding)*	Intense periods of rainfall caused flash floods and the capacity of the existing drainage system to be exceeded in several locations across the Borough. This caused overland flow and ponding in low lying areas and impacted residents, businesses and the Council. 50.8mm of rainfall was recorded in 24 hours, the majority of this fell in the first 12 hour period.
	Merton Borough Council reported significant flooding in the areas of West Barnes, Morden, Mitcham, Colliers Wood, Tooting Graveney and Summerstown.
	London Underground records report the closure of Colliers Wood and Morden Stations due to surface water flooding. Colliers Wood Station was closed for 9 hours.
	Over 120 roads in the Borough (approximately 65,000m^2 of public highway) were impacted by the surface water flooding, with over 140 calls received by the Environment and Regeneration team advising of flooding and requesting sandbags.
	Approximately 30 residential council properties, 1 youth centre, 3 libraries, 10 leisure and recreation properties and 6 corporate buildings were flooded.
	23 schools, 20 primary, 1 special school and 1 high school were affected to varying degrees by the flooding, with one school requiring an extra three days to finalise repairs over the summer holidays.
	The High Street in Colliers Wood was flooded. This is one of the busiest roads in Merton and is the main route to St. Georges Hospital and the National Blood Service, which uses this route for most of the hospitals in Surrey, Kent and Sussex. St George's Hospital car park was flooded. High Street Colliers Wood is a red-route and comes under the responsibility of TfL.
Regular Flooding *(Surface Water & Sewer Flooding)*	The West Barnes / Raynes Park area is known to flood during heavy rainfall and result in overland flow / surface water flooding and sewer flooding, due to an overloaded drainage system during significant rainfall events.

The PFRA and SWMP identify parts of Merton to be particularly susceptible to surface water flooding, including West Barnes / Raynes Park, Colliers Wood and East Mitcham, particularly in the area of Manor Road / Manor Way. 276 records of surface water flooding have been provided by the Council and mapped in **Appendix A Figure 3.2.** Specific episodes of surface water flooding are recorded in the following locations:

- West Barnes,
- Raynes Park,
- Morden,
- St Helier and
- Colliers Wood

The SWMP for London Borough of Merton identifies 13 CDAs, as summarised in Table 5-3. The Environment Agency defines a Critical Drainage Area (CDA) as an area within Flood Zone 1 which has 'critical drainage issues'. However, within the SWMPs for each of the London Boroughs, CDAs were delineated based on the following 'working definition': 'a discrete geographic area (usually within an urban setting) where there may be multiple and interlinked sources of flood risk and where severe weather is known to cause flooding of the area thereby affecting people, property or local infrastructure'. Therefore the CDAs for the London Boroughs are not restricted to Flood Zone 1.

Table 5-3 SWMP CDAs in London Borough of Merton

CDA ID	CDA Name
Group7_001	West Barnes
Group7_002	Raynes Park
Group7_003	Hillcross
Group7_004	Cottenham Park North
Group7_005	Cottenham Park South
Group7_006	Glastonbury Road
Group7_007	North St. Helier
Group7_008	Wimbledon
Group7_009	Haydon
Group7_010	East Merton
Group7_011	Collier's Wood
Group7_012	East Mitcham
Group7_013	Ascot Road [Merton]

5.3.2 Updated Flood Map for Surface Water

The updated Flood Map for Surface Water (uFMfSW) presented in **Appendix A Figure 3.2** supports many of the records of flooding and illustrates how surface water ponds in the flat low lying areas within the Borough, within the floodplains of the primary watercourses and adjacent to railway embankments. As part of the Level 1 SFRA, 19 Drainage Catchments (DC) have been identified in Merton in order to better understand and manage the risk from surface water flooding, as shown in **Appendix A Figure 3.3**. These Drainage Catchments follow the topography and watercourse catchments within the Borough, but are also influenced by the presence of railway embankments, which cut through the Borough from New Malden to Earlsfield and create barriers to overland flow. It is intended that these DCs will be useful for identifying the natural drainage patterns in the local area when considering new development and future regeneration in the study area.

5.4 Flooding from Groundwater

5.4.1 Historic Records

The Council have records of 34 incidents of groundwater flooding in the Borough which are shown in **Appendix A Figure 3.4**. These incidents are dispersed across the Borough, including West Barnes, north of Cottenham Park, Colliers Wood, Wimbledon and Morden.

The most notable groundwater flooding event occurred during late 2000 / early 2001 after a particularly wet period which resulted in both surface and groundwater flooding incidents in a number of locations across the country.

5.4.2 Susceptibility to Groundwater Flooding

The Susceptibility to Groundwater Flooding dataset provided by the BGS can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

The areas identified to be most susceptible to groundwater flooding across the Borough are located in those areas with permeable superficial deposits (which usually consist of sediments such as gravel, sand, silt and clay) which are typically associated with river valleys. These cover a wide area in Merton and include the following areas:

- From Mitcham north towards Collier's Wood,
- Sections of West Barnes and Raynes Park, and
- An area of central Merton from South Wimbledon west towards Cottenham Park.

Smaller areas, where there is potential for groundwater flooding of property situated below ground level, are located in Mitcham, Collier's Wood and South Wimbledon, whilst Wimbledon Common and areas in close proximity to this are identified to have limited potential for groundwater flooding to occur. However, it should be noted that the Susceptibility to Groundwater Flooding dataset provides a high-level assessment of potential risk across the Borough and incidents may occur outside these areas depending on the local geological conditions.

5.5 Flooding from Sewers

5.5.1 Historic Records

The majority of Merton is served by separate foul and surface water sewers, with the exception of combined sewers in north of the Borough. The surface water sewers typically designed to accommodate a rainfall event with a 1 in 30 chance of occurring in any given year or less. During larger, more intense rainfall events when the capacity of the surface water sewer system is insufficient, many of the sewer systems in the south west of the Borough discharge directly, or via some degree of attenuation on new development sites, into the natural watercourses in the Raynes Park area. These discharges can locally increase water levels and potential for flooding.

The London Borough of Merton PFRA states that the West Barnes, Raynes Park and Colliers Wood areas in particular are known to experience sewer flooding during heavy rainfall.

Appendix A Figure 3.5 shows the DG5 Register that has been supplied by TWUL. It highlights sewer flooding incidents throughout London Borough of Merton; however it should be noted that TWUL focus their efforts on removing properties from the DG5 register and therefore this information may not accurately represent those properties currently at risk.

5.5.2 Climate Change

Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events. However as the majority of the Borough is served by separate foul and surface water sewers the risk from sewer flooding in the London Borough of Merton is considered to be low.

TWUL continue to monitor the risk of sewer flooding and put plans in place to manage the risk, as required, based on their business plan and priorities. London Borough of Merton can work with TWUL to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated. TWUL prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company.

5.6 Flooding from Other Sources

5.6.1 Risk of Flooding from Reservoirs

There have been no recorded incidents of reservoir flooding within London Borough of Merton. The Environment Agency Flood Risk from Reservoirs mapping available online identifies that if Wimbledon Park Lake were to fail there is the potential for wide-scale flooding downstream. Flood waters would flow north-east from Wimbledon Park Lake into the River Wandle and into the London Borough of Wandsworth, and subsequently northwards towards the River Thames.

Table 5-4 Areas at risk of flooding from reservoirs

Name	Owner	Local Authority	Grid Ref	Areas affected
Wimbledon Park Lake	London Borough of Merton	London Borough of Merton	524874, 172403	Drains north east towards Durnsford Road and Earlsfield. Follows the course of the River Wandle into King George's Park in London Borough of Wandsworth.

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers on a yearly basis. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency are responsible for ensuring that reservoirs are inspected regularly and essential safety work is carried out. As the undertaker for Wimbledon Park

Lake, London Borough of Merton is required to ensure that inspections are carried out by a qualified panel engineer and that necessary safety work is completed as required to reduce the likelihood of any failure.

5.7 Summary of Flood Risk in London Borough of Merton

Table 5-5 provides a summary of the number of residential, non-residential and unclassified properties within each flood zone, and Table 5-56 provides a summary of the number of properties which intersect with the Low, Medium and High designations within the uFMfSW. The property counts have been provided by Drainage Catchment (as shown in **Appendix A Figure 3.3**).

Table 5-5 Properties at risk of fluvial flooding in London Borough of Merton by Drainage Catchment

Drainage Catchment	Flood Zone 1			Flood Zone 2			Flood Zone 3a			Flood Zone 3b		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC4	457	16	66	13	0	1	1	0	0	1	1	4
DC14	13	14	50	7	3	13	6	10	40	0	2	3
DC15	135	57	72	0	0	0	0	0	0	0	0	0
DC16	3114	220	400	60	3	13	0	15	3	2	1	4
DC17	821	56	217	0	0	0	0	0	0	0	0	0
DC18	3257	230	243	0	0	0	0	0	0	0	0	0
DC19	1828	31	98	0	0	0	0	0	0	0	0	0
DC22	1980	55	62	347	7	9	89	2	2	10	0	3
DC23	16,341	301	1,301	1,848	82	123	293	2	8	72	2	12
DC24	7,323	390	584	623	32	46	257	27	3	0	3	3
DC25	3,675	337	489	452	68	82	306	13	20	19	5	6
DC26	15,517	1,275	1,037	425	23	37	21	14	1	0	0	0
DC27	4,425	105	184	0	0	0	0	0	0	0	0	0
DC28	6,345	201	412	0	0	0	0	0	0	0	0	0
DC29	6,119	157	571	430	13	50	188	14	40	107	1	9
DC30	2,177	109	175	664	68	78	62	2	2	36	4	5
DC33	1,854	81	399	162	17	34	35	0	10	7	0	7
DC36	3,483	63	136	75	0	3	14	2	7	0	1	5
DC38	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**78,864**	**3,698**	**6,496**	**5,106**	**316**	**489**	**1,272**	**101**	**136**	**254**	**20**	**61**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the Flood Zones. Where properties intersect two Flood Zones, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [1]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[1] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

Table 5-6 Properties at risk of surface water flooding in London Borough of Merton by Drainage Catchment

Drainage Catchment	uFMfSW Low			uFMfSW Medium			uFMfSW High		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC4	135	3	10	11	0	0	3	0	2
DC14	11	8	33	1	1	9	0	1	10
DC15	57	9	22	11	4	5	9	3	0
DC16	634	104	102	107	28	2	107	17	38
DC17	142	8	16	14	0	2	8	0	3
DC18	839	95	68	254	22	8	127	30	25
DC19	326	6	13	42	6	6	219	2	5
DC22	752	11	17	137	1	5	52	4	2
DC23	3948	82	453	731	64	18	131	9	51
DC24	1567	84	147	460	35	5	194	9	4
DC25	792	100	170	125	31	15	29	15	13
DC26	3287	311	273	449	120	51	112	51	27
DC27	1716	51	89	343	26	10	126	5	12
DC28	1969	73	114	600	23	9	158	11	11
DC29	1898	99	197	499	19	26	148	4	15
DC30	691	70	113	307	30	16	16	3	6
DC33	331	25	57	88	11	2	37	8	13
DC36	635	8	42	182	18	1	192	4	10
DC38	0	0	0	0	0	0	0	0	0
TOTAL	**19730**	**1147**	**1936**	**4361**	**439**	**190**	**1668**	**176**	**247**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the categories within the uFMfSW. Where properties intersect two or three categories from the uFMfSW, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [2]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[2] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

6 Flood Risk in the London Borough of Sutton

6.1 Overview

This Section provides the strategic assessment of flood risk across the **London Borough of Sutton** from each of the sources of flooding outlined in the NPPF. For each source of flooding, details of any historical incidents are provided, and where appropriate, the impact of climate change on the source of flooding is described. This Section should be read with reference to the figures in Appendix A.

6.2 Flooding from Rivers

6.2.1 Flood Zones

The vast majority of London Borough of Sutton (96%) is defined as Flood Zone 1 Low Probability of flooding from rivers. Approximately 2% is defined as Flood Zone 2 Medium Probability, >1% as Flood Zone 3a High Probability, and <1% as Flood Zone 3b Functional Floodplain.

The sources of the River Wandle are springs at both Carshalton and Waddon, which rise at the junction between the Chalk geology and the overlying Clays and Gravels. The Carshalton and Waddon branches combine at Hackbridge then flow through Mitcham, where a short tributary called the Beddington Corner branch also joins the main channel. This branch carries discharge from Beddington Sewage Treatment Works. **Appendix A Figure 4.1** identifies areas of Flood Zone 2 and 3 associated with the River Wandle including industrial estates around Beddington Lane, residential properties to the west of London Road (A237) between Wallington Bridge and Wandle Bridge, and areas of residential properties throughout Hackbridge through to Mill Lane.

The Beverley Brook passes along the western boundary of Sutton's administrative area; this watercourse rises in Cuddington Park and it subsequently culverted until Worcester Park Sutton. The channel of this watercourse has historically been heavily modified. The Beverley Brook flood alleviation scheme in Worcester Park was completed in 2012, utilising green spaces for temporary storage of flood waters. The scheme has raised the protection from flooding for approximately 90 properties. **Appendix A Figure 4.1** shows that land and properties within the Beverley Brook river corridor including Green Lane, Central Road (A2043), Hazelmere Gardens and Green Lane Primary School are located within Flood Zones 2 and 3a.

The Pyl Brook is a tributary of the Beverley Brook which rises to the south of Sutton Common train station at the junction between the Chalk and the overlying Clays and flows south-east to north-west towards the London Borough of Merton. The Anton Crescent Wetland to the south of the watercourse is used as a formal flood storage area when required. Areas of Flood Zone 2 and 3a associated with the Pyl Brook include land and properties adjacent to the Pyl Brook on Hamilton Avenue and Trafalgar Avenue, Watson Avenue, Westbourne Avenue and Warner Avenue, Willow Walk and Sunnyhurst Close.

The East Pyl Brook, which is a tributary of the Pyl Brook, rises approximately 200m north of the Pyl Brook and flows approximately northwards towards Morden Park in the London Borough of Merton. Sections of both branches of the Pyl Brook are culverted (e.g. beneath the A217 and the railway line) and the channel is heavily engineered. Land adjacent to the East Pyl brook including Glastonbury Road, Rosehill Recreation Ground and Glenthorne Recreation Ground are shown to be within Flood Zone 2 and 3a in **Appendix A Figure 4.1.**

6.2.2 Functional Floodplain

Modelled outlines for the 5% AEP event, including the presence of flood defences, for the River Wandle and Beverley Brook have been used by London Borough of Sutton to define Functional Floodplain associated with these watercourses and has been mapped in **Appendix A Figure 4.1**. London Borough of Sutton has not removed any buildings from the 5% AEP event flood extent for the River Wandle and Beverley Brook, as it cannot be verified that finished floor levels are high enough to prevent inundation.

6.2.3 Historic Records

The Environment Agency Historic Flood Map included in **Appendix A Figure 4.1** shows the extent of historic flood events. These are from 1937 and 1968 during which flooding occurred along the river corridors of the Pyl Brook, the East Pyl Brook and the Beverley Brook on both occasions. Flooding recorded in 1968 was associated with the Beverley Brook in and around Worcester Park. Considerable flooding associated with the Beverley Brook and Pyl Brook was also experienced in July 2007.

Of the records of flooding reported in London Borough of Sutton, 25 are associated with fluvial flooding. As shown in **Appendix A Figure 4.1** these are clustered along the River Wandle around Hackbridge and Beddington Corner, and adjacent to the Beverley Brook on Green Lane.

6.2.4 Climate Change

Appendix A Figure 4.1 includes the modelled outline for the 1% AEP event including an allowance for climate change for the River Wandle, Beverley Brook and Pyl Brook. As described in Section 3.2.5, this is generated by considering an increase in peak flow as a result of the anticipated effects of climate change. These modelled scenarios also include the presence of flood defences along the watercourses. In general the results show a minimal increase in the extent of flooding during these modelled scenarios when considering the impact of climate change. There is a noticeable increase in the extent of flooding at the head of the Pyl Brook, just upstream of the A217.

6.2.5 Ordinary Watercourses

There is approximately 20km of ordinary watercourse in Sutton, approximately 1.6km of which is culverted. These are mainly located in and around Beddington Park and Beddington Sewage Treatment Works. Shorter sections of ordinary watercourse are located in the northern section of the Borough, most notably in Rosehill Park and Cheam Park. A number of these watercourses are small ditches located in parks, for which Sutton Council are the riparian owners and risk management authority.

Of the incidents of flooding reported to London Borough of Sutton, there are no records of flooding associated with ordinary watercourses. It is possible that flooding incidents have occurred but have not been reported to Sutton Council, and therefore not recorded. Therefore it is possible that the occurrence of flooding originating from ordinary watercourses is under represented in Sutton Council records.

Within Sutton, 1.6km of ordinary watercourse are culverted, with trash screens often located on the upstream end of culverts. Trash screens and culverts have the potential to become blocked by items such as plant debris and rubbish. Blockages can restrict the natural flow of water, increasing the chance of water flowing out of bank and causing local flooding due to the reduced conveyance potential of the associated watercourse. Therefore the risk of flooding from ordinary watercourses can be localised and is dependent on adopting appropriate inspection and maintenance regimes to ensure this risk is minimised where possible. This could be included as a future action within Sutton Council's LFRMS[33] to help deliver Objective 1: *Improve our understanding and data holdings regarding mechanisms of flooding in Sutton*.

6.2.6 Flood Defences

Extracts from the Environment Agency Asset Information Management System (AIMS) provided to inform the Level 1 SFRA show that the River Wandle is predominantly protected by high ground along its course. To the west of the B272 in Beddington the watercourse divides into two channels, one of which is culverted, whilst the other is protected by a flood defence wall.

Similarly, the majority of the Beverley Brook is protected by high ground along its length. There are short sections of flood wall as the watercourse passes through Worcester Park and Motspur Park. The watercourse flows in culvert beneath the railway lines and the A3.

Both arms of the Pyl Brook are culverted beneath the A217. The remainder of the watercourse that is present in London Borough of Sutton is protected by high ground.

The AIMS dataset is shown in **Appendix A Figure 4.1 Inset Maps.**

6.2.7 Flood Warning Areas

There are four Environment Agency Flood Warning Areas in London Borough of Sutton, identified in **Appendix A Figure 4.6,** as follows:

[33] Sutton Council, Capita URS, July 2014, London Borough of Sutton Local Flood Risk Management Strategy, Draft for consultation.

- River Wandle at Beddington Park
- River Wandle at Morden
- Pyl Brook at North Cheam
- Beverley Brook at Worcester Park

6.2.8 Emergency Rest Centres

Emergency rest centres designated by London Borough of Sutton are mapped in **Appendix A Figure 4.1** and summarised in Table 5-1.

Table 6-1 Emergency Rest Centres in London Borough of Sutton

ID	Address	Easting	Northing
1	Cheam Priory Day Centre, 316 Malden Road, Cheam, SM3 8EP	523753	164820
2	The Phoenix Centre, Mollison Drive, Wallington, SM6 9NZ	530085	163225
3	Salvation Army Hall, Benhill Avenue, Sutton, SM1 4DD	525913	164655
4	Sutton Sports Arena, Middleton Road, Carshalton, SM5 1SL	526646	166573
5	Sutton Life Centre, 24 Alcorn Close, Sutton, SM3 9PX	525242	165961
6	Sutton Lodge, 139 Brighton Road, Sutton, SM2 5SW	525914	162716

6.3 Flooding from Surface Water

6.3.1 Historic Records

Significant surface water flooding occurred in Sutton in the summer of 2007 and the SWMP and LFRMS for London Borough of Sutton records that drainage systems were overwhelmed across the Borough in 2007, 2008, 2009 and 2010. The PFRA and SWMP identify parts of Sutton to be particularly susceptible to surface water flooding, including Manor Road, where surface water passes underneath the railway bridge near Wallington Station, properties along a number of streets to the north of the Royal Marsden Hospital and streets to the south of Sutton Town Centre.

36 records of surface water flooding are presented in **Appendix A Figure 4.2** and specific episodes of surface water flooding are recorded in the following locations:

- Beddington
- Worcester Park
- North Cheam
- St Hellier
- Wallington
- North of The Royal Marsden Hospital
- Hackbridge (flooding from multiple sources, including surface water)

The areas at greatest risk within Sutton were identified as Critical Drainage Areas (CDAs) within the SWMP, The Environment Agency defines a Critical Drainage Area (CDA) as an area within Flood Zone 1 which has 'critical drainage issues'. However, within the SWMPs for each of the London Boroughs, CDAs were delineated based on the following 'working definition': 'a discrete geographic area (usually within an urban setting) where there may be multiple and interlinked sources of flood risk and where severe weather is known to cause flooding of the area thereby affecting people, property or local infrastructure'. Therefore the CDAs for the London Boroughs are not restricted to Flood Zone 1. Twelve CDAs have been identified across Sutton as presented in Table 6-2.

Table 6-2 SWMP CDAs in London Borough of Sutton

CDA ID	CDA Name
Group8_022	Worcester Park/Green Lane
Group8_023	Trafalgar Avenue
Group8_024	Sandy Lane
Group8_025	York Rd/Mulgrave Rd
Group8_026	Sutton Junction
Group8_027	Carshalton Beeches
Group8_028	Carshalton Centre
Group8_029	Beddington Gardens
Group8_030	Wallington Station
Group8_031	Sth Beddington
Group8_032	Beddington Park
Group8_033	Hackbridge

6.3.2 Updated Flood Map for Surface Water

The updated Flood Map for Surface Water (uFMfSW) presented in **Appendix A Figure 4.2** supports many of the records of flooding.

The Borough is bisected by Epsom to Clapham Junction the railway line running east – west across the area. The uFMfSW mapping illustrates how surface water runs down the natural channels in the south of the Borough and accumulates adjacent to the railway line and in the low points beneath bridge crossings. In the north of the Borough, surface water ponding is shown to occur within the floodplain of the main watercourses, namely the Beverley Brook, Pyl Brook and River Wandle. As part of the Level 1 SFRA, 17 Drainage Catchments (DC) determined across the London Borough of Sutton in order to better understand and manage the risk from surface water flooding, as shown in **Appendix A Figure 4.3**. The DCs are based on the natural catchments and watersheds provided within the Flood Estimation Handbook CD-ROM which have then been amended using local knowledge to account for significant infrastructure within the study area that could impact on drainage such as railway lines. It is intended that these DCs will be useful for identifying the natural drainage patterns in the local area when considering new development and future regeneration in the study area.

6.4 Flooding from Sewers

6.4.1 Historic Records

The majority of Sutton is served by separate foul and surface water sewers, with the exception of combined sewers in Hackbridge / Beddington and the north-west of the Borough. The surface water sewers are typically designed to accommodate a rainfall event with a 1 in 30 chance of occurring in any given year or less. During larger, more intense rainfall events when the capacity of the surface water sewer system is insufficient, many of the sewer systems in the south west of the Borough discharge directly, or via some degree of attenuation, into the natural watercourses of the area. These point discharges can locally increase flood levels in some reaches and, by delivering water rapidly to the watercourse, be an important component of overall flood volume. In the very south of the Borough, systems discharge to soakaways and therefore there is a limited surface water sewer network.

As part of the SWMP, TWUL provided information (through their DG5 register) on the total number of properties affected by sewer flooding (both internally and externally) based on historic flooding over the previous 10 years. TWUL focus their efforts on removing properties from the DG5 register and therefore this dataset may not accurately represent those properties currently at risk. The information presented within the SWMP highlights the wards of Worcester Park, North Cheam, Rosehill and the northern part of Carshalton as having experienced a greater number of sewer flooding incidents than the rest of the Borough.

Appendix A Figure 4.5 shows the DG5 Register that has been supplied by TWUL. It highlights sewer flooding incidents throughout London Borough of Merton; however it should be noted that TWUL focus their efforts on removing

properties from the DG5 register and therefore this information may not accurately represent those properties currently at risk.

Sutton is also aware of a number of locations that have historically experienced problems with sewer flooding, including:

- Surcharging of surface water sewer system at Wallington Rail Bridge. New soakaway chambers have been installed in this location to alleviate pressure on the sewer system.
- Flooding along Cedar Road partially attributed to the design of the surface water sewers at this location.
- Sewer flooding on Nightingale Close which is caused by surcharging of the surface water drainage outfall to the River Wandle during high water levels. This leads to the backing up of floodwater into Nightingale Close.
- In Worcester Park, there are four large outfalls enter the channel of the Beverley Brook. The system may be surcharged during periods of high flow in the Beverley Brook resulting in flooding upstream.
- In Trafalgar Avenue the largest pipe out falling to the Pyl Brook is a 457mm flowing from the south west; high water levels in the watercourse may result in flooding of the surrounding area.

6.4.2 Climate Change

Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents. Any sewer flooding that may occur could be exacerbated as a result of surface water runoff during extreme rainfall events. However the risk from sewer flooding in the London Borough of Sutton is low as the majority of Sutton is served by separate foul and surface water sewers. TWUL will monitor the risk of sewer flooding and put plans in place to manage this, as required, based on their business plan and priorities. The London Borough of Sutton will work with TWUL to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated.

TWUL will prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company. The Action Plan for Sutton Council's LFRMS[33] identifies actions and measures to seek opportunities to carry out flood alleviation works to reduce the likelihood of flooding in Sutton. Future actions could be to include TWUL as a partner for sewer flood alleviation works.

The SWMP states that during high fluvial flows, river outlets can be submerged thereby reducing the capacity for water to discharge into watercourses. Water has the potential to flow back up the sewer network and, if sewer capacity is reached, surcharge. The SWMP identifies this process as being of particular concern in Hackbridge where combined sewers outfall into the River Wandle. However, overall, sewer flooding is not considered to be significant flood risk across the Borough.

6.5 Flooding from Groundwater

6.5.1 Historic Records

With the exception of one groundwater flooding event in proximity to Sutton Police Station, all recorded groundwater flood incidents held by Sutton Council are located in the north-west of the Borough, north of the A232, and west of the rail line running through the Borough from Sutton station to Mitcham Junction station (**Appendix A Figure 4.4**).

The SWMP identifies the majority of recorded incidents occurred in 2001, noted as being a particularly wet period. Initial analysis in the SWMP identified a number of the flooding incidents as occurring over the London Clay Formation and therefore flooding may potentially be related to poor drainage over clayey soils following heaving rainfall as opposed to groundwater flow.

The high groundwater levels experienced from December 2013 to April 2014 caused the Carshalton Park Canal and the Carshalton Place Canal (tributaries of the River Wandle) to flow for the first time in over 10-15 years. Although flooding to properties was minimal during this time, work was required to manage the flows in The Grove and Carshalton Park and to avoid Carshalton High Street from being flooded.

6.5.2 Susceptibility to Groundwater Flooding

The Susceptibility to Groundwater Flooding dataset provided by the BGS can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface. This dataset is presented in **Appendix A Figure 4.4**.

The Borough of Sutton is divided into two distinct areas with respect to bedrock geology. The north of the Borough is underlain by impermeable London Clay, whereas the south is underlain by permeable chalk. Permeable river terrace deposits are present in the north east of the Borough, along the River Wandle corridor. A band of consolidated aquifers runs along the centre of the Borough concentrated in Wallington and Cheam. The Susceptibility to Groundwater Flooding dataset presented in **Appendix A Figure 4.4** indicates that there is potential for groundwater flooding to occur at the surface in the north and east of the Borough. In the north of the Borough permeable river terrace deposits are present which are providing potential pathways for groundwater during periods of elevated groundwater levels in the underlying chalk aquifer. In the east, consolidated aquifers are present. The south of the Borough is largely shown to be an area where there is limited potential for groundwater flooding to occur.

Recorded incidents of groundwater flooding do not appear to correspond with areas susceptible to groundwater flooding, with few recorded groundwater flooding incidents located in the north-east of the Borough. As discussed above, this may be due to a number of flooding incidents being incorrectly identified as having a groundwater source. Therefore groundwater flooding incidents may potentially occur outside these areas in the future. However, there is also a lack of detailed understanding of the sub-surface substrates, fault lines and fissures that could impact the flow of groundwater in Sutton, therefore it is recommended that work should be done in the future to identify the source of flooding when it occurs.

The SWMP also notes that future flood risk from groundwater may be impacted by the numerous water supply abstractions that are present within Sutton.

6.6 Flooding from Other Sources

6.6.1 Risk of Flooding from Reservoirs

There have been no recorded incidents of reservoir flooding within London Borough of Sutton. The Environment Agency Flood Risk from Reservoirs mapping available online identifies that if the Russell Hill Reservoir in London Borough of Croydon were to fail floodwaters would flow northward to the east of Bandon Hill and Church Paddock and into Beddington Park, impacting areas of Wallington and Hackbridge around the route of the River Wandle in London Borough of Sutton.

Table 6-3 Areas at risk of flooding from reservoirs

Name	Owner	Local Authority	Grid Ref	Areas affected
Russell Hill	Thames Water Utilities Ltd	Croydon	531451, 162811	From Roundshaw Park northwards along the A23 towards Stafford Road and Waddon railway station. Veers west and branches following the course of the River Wandle towards Beddington and Hackbridge in London Borough of Sutton.

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers on a yearly basis. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency are responsible for ensuring that reservoirs are inspected regularly and essential safety work is carried out. As the undertaker for Russell Hill Reservoir, TWUL is required to ensure that inspections are carried out by a qualified panel engineer and that necessary safety work is completed as required to reduce the likelihood of any failure.

6.7 Summary of Flood Risk in London Borough of Sutton

Table 6-4 provides a summary of the number of residential, non-residential and unclassified properties within each flood zone, and Table 6-5 provides a summary of the number of properties which intersect with the Low, Medium and High designations within the uFMfSW. The property counts have been provided by Drainage Catchment (as shown in **Appendix A Figure 4.3**).

Table 6-4 Properties at risk of fluvial flooding in London Borough of Sutton by Drainage Catchment

Drainage Catchment	Flood Zone 1			Flood Zone 2			Flood Zone 3a			Flood Zone 3b		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC25	0	0	1	0	0	0	0	0	0	0	0	0
DC29	3,675	99	161	150	3	4	0	1	0	0	2	2
DC30	5,746	302	487	61	3	5	86	0	6	43	1	0
DC31	3,107	78	270	18	0	1	5	0	0	1	0	0
DC32	6,713	119	438	37	0	0	23	0	0	5	0	1
DC33	16,129	769	967	178	34	47	102	7	5	19	1	4
DC34	6,217	191	257	83	0	2	0	0	0	0	0	0
DC35	1,381	11	44	3	0	1	0	0	0	0	0	0
DC36	1,457	99	45	0	0	0	0	0	0	0	0	0
DC37	12,617	402	747	1,217	103	59	549	12	24	130	6	13
DC38	161	199	364	13	23	56	0	0	0	0	0	0
DC39	261	1	1	0	0	0	0	0	0	0	0	0
DC47	6	2	12	0	0	0	0	0	0	0	0	0
DC48	5,110	188	227	0	0	0	0	0	0	0	0	0
DC49	3,770	242	213	0	0	0	0	0	0	0	0	0
DC50	2,336	103	344	0	0	0	0	0	0	0	0	0
DC51	5,683	233	781	129	1	6	57	0	8	0	1	0
DC52	1,983	198	340	0	0	0	0	0	0	0	0	0
TOTAL	**76,352**	**3,236**	**5,699**	**1,889**	**167**	**181**	**822**	**20**	**43**	**198**	**11**	**20**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the Flood Zones. Where properties intersect two Flood Zones, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [1]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[1] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

Table 6-5 Properties at risk of surface water flooding in London Borough of Sutton by Drainage Catchment

Drainage Catchment	uFMfSW Low			uFMfSW Medium			uFMfSW High		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC25	0	0	1	0	0	0	0	0	0
DC29	576	9	24	196	4	8	85	10	7
DC30	1,143	62	69	506	23	28	302	25	17
DC31	755	33	65	218	14	17	134	3	4
DC32	1,066	15	77	322	5	16	199	4	20
DC33	3,718	252	211	1,146	103	70	1,068	130	73
DC34	1,240	72	64	268	6	18	102	4	3
DC35	120	0	14	73	1	2	27	1	5
DC36	138	5	4	51	2	1	0	0	0
DC37	3,187	110	173	612	70	44	343	16	28
DC38	35	81	84	20	26	30	10	32	10
DC39	40	0	0	6	0	0	0	0	0
DC47	0	0	0	0	0	0	0	0	0
DC48	910	65	32	365	6	8	176	3	3
DC49	688	66	42	63	23	7	45	15	10
DC50	388	36	35	92	0	5	86	1	13
DC51	1,024	30	105	242	41	37	208	19	20
DC52	401	34	78	107	1	12	75	4	6
TOTAL	**15,429**	**870**	**1,078**	**4,287**	**325**	**303**	**2,860**	**267**	**219**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the categories within the uFMfSW. Where properties intersect two or three categories from the uFMfSW, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [2]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[2] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

7 Flood Risk in the London Borough of Wandsworth

7.1 Overview

This Section provides the strategic assessment of flood risk across the **London Borough of Wandsworth** from each of the sources of flooding outlined in the NPPF. For each source of flooding, details of any historical incidents are provided, and where appropriate, the impact of climate change on the source of flooding is described. This Section should be read with reference to the figures in Appendix A.

7.2 Tidal Flooding

7.2.1 Flood Zones

The River Thames forms the northern boundary of the London Borough of Wandsworth. At this point along its course, the water levels in the River Thames are tidally influenced. Flood Zone mapping included in **Appendix A Figure 5.1** identifies that a large area covering Battersea and Clapham Junction and smaller areas to the north of Wandsworth and Putney are in Flood Zone 3 associated with the River Thames, which is defined as land that would be expected to flood during a flood event with a 0.5% AEP, when excluding the presence of defences.

In the London Borough of Wandsworth, areas of Flood Zone 3 associated with the River Thames are also defined as ABD, i.e. they are shown to benefit from the presence of flood defences during a 0.5% AEP flood event. The Thames Tidal Defence (TTD) system includes both the raised flood defence walls along the River Thames frontage, as well as the Thames Barrier located downstream at Woolwich.

The risk of tidal flooding to these northern parts of Wandsworth is therefore a residual risk, in the event of a breach or overtopping of the local flood defences.

7.2.2 Historic Records

The Environment Agency Historic Flood Map, shown in **Appendix A Figure 5.1**, presents historic river flood extents from 1928, 1937 and 1968. Of these years, flooding from rivers only impacted Wandsworth in 1928. The flooding was limited to areas In Battersea, Nine Elms and Wandsworth that are adjacent to the River Thames.

Of the flood records provided for the Level 1 SFRA, there is only 1 record of tidal flooding, which is on Putney Embankment.

7.2.3 Flood Defences

Extracts from the Environment Agency Asset Information Management System (AIMS) provided to inform the Level 1 SFRA show that the River Thames is predominantly defended by the presence of flood walls, as well as a section of embankment at Wandsworth Park. The AIMS dataset is shown in **Appendix A Figure 5.1 Inset Maps.**

The TE2100 Plan states that the policy for this area of Wandsworth is 'P5' – to take further action to reduce flood risk beyond that required to keep pace with climate change. The Plan states that a higher standard of protection will be provided by the Thames Barrier for tidal flood risk for the foreseeable future. Towards the end of the century major investment will be required and the TE2100 appraisal demonstrates that given the commercial, economic and historic value of London, as well as the potential for loss of life in the unlikely event of a flood, a 1:10,000 year standard will be justified for P5 areas. In the Wandsworth to Deptford Thames embayment area there may also be opportunities to set back defences and improve riverside amenity and habitats.

7.2.4 Residual Risk – Breach Modelling

In March 2015, the Thames Tidal Breach Modelling Study[34] was completed for the Environment Agency. The purpose of this Study was to simulate a series of breach scenarios along the Thames frontage, to quantify the residual risk of tidal flooding. In total, 113 breach locations were modelled as part of this study. The results from 12 of these breach locations are of relevance to London Borough of Wandsworth.

[34] CH2MHill, March 2015, Thames Tidal Breach Modelling Study.

The London Borough of Wandsworth is located upstream of the Thames Barrier. In this location, return periods cannot be applied to water levels in the same manner as they can downstream of the Barrier, as water levels are a function of the maximum tide level allowed through the Barrier, as defined by the barrier closure rule / matrix. As a result, a Maximum Likely Water Level (MLWL) is applied. The following scenarios have been simulated upstream of the Barrier:

- Maximum Likely Water Level under present day (2014) climate change conditions.
- Maximum Likely Water Level under climate change conditions for the year 2065.
- Maximum Likely Water Level under climate change conditions for the year 2100.

Table 7-1 Thames Tidal Breach Modelling Parameters, Wandsworth (Automated Breach Factsheet, CH2MHill 2015)

Breach Name	Breach Location	Defence Type	Breach Width (m)	Invert Level (m AOD)	Duration (hours)	Breach Coordinates	
Barn05	Beverley Brook, Barnes	Wall	20	3.69	35	523426	176346
Barn07	Putney High Street	Wall	20	6.12	35	524068	175685
Clp01	Bell Lane Creek	Wall	20	4.88	35	525506	175275
Clp02	Wandsworth Park	Wall	20	4.23	35	524429	175493
Berm16	New Covent Garden	Wall	20	4.18	35	529971	177851
Berm17	Prescott Wharf, Nine Elms	Wall	20	3.25	35	529590	177658
Berm18	Grosvenor Bridge, Battersea Power Station	Wall	20	4.8	35	528861	177687
Berm19	Albert Bridge	Wall	20	4.37	35	527546	177435
Berm20	Ransome's Dock, Battersea	Wall	20	3.96	35	527330	177361
Berm22	York Road, Battersea	Wall	20	4.66	35	526505	175983
Berm23	Wandsworth Bridge	Wall	20	3.87	35	526105	175521
Berm24	Vicarage Crescent, Battersea	Wall	20	4.54	35	526684	176493

One of the outputs of this modelling is flood hazard mapping which categorises the danger to people for different combinations of flood water depth and velocity. The derivation of these categories is based on the methodology set out by Defra in Flood Risks to People FD232035 using the following equation:

*Flood Hazard Rating = ((v+0.5)*D) + DF*

Where v = velocity (m/s), D = depth (m), DF = debris factor

Table 7-2 Hazard categories based on FD2320, Defra & Environment Agency 2005

Flood Hazard		Description
Low	HR < 0.75	**Caution** – Flood zone with shallow flowing water or deep standing water
Moderate	0.75 ≥ HR ≤ 1.25	**Dangerous for some** (i.e. children) – Danger: flood zone with deep or fast flowing water
Significant	1.25 > HR ≤ 2.0	**Dangerous for most people** – Danger: flood zone with deep fast flowing water
Extreme	HR > 2.0	**Dangerous for all** – Extreme danger: flood zone with deep fast flowing water

The hazard mapping for the three modelled scenarios is presented in **Appendix A Figure 5.7, Figure 5.8 and Figure 5.9** and summarised below:

[35] Defra and Environment Agency (2005) FD2320 Flood Risks to People.

Figure 5.7 MLWL for the Year 2014

- Flooding is shown to occur from breach locations at New Covent Garden (Berm16) and Prescott Wharf (Berm17). Floodwater flows along Nine Elms Lane and the railway lines in this area, generating a flood hazard rating ranging from Low to Significant.

- There is a small extent of flooding associated with Ransome's Dock (Berm20). The hazard rating is Low.

- There are small extents of flooding with Significant hazard rating associated with breaches at York Road (Berm22) and Wandsworth Bridge (Berm23).

Figure 5.8 MLWL for the Year 2065

- Flooding associated with New Covent Garden (Berm16) and Prescott Wharf (Berm17) covers a greater extent, stretching south to Wandsworth Road. The hazard rating along Nine Elms Lane is increased to Extreme.

- Battersea Power Station site is shown to flood, as a result of a breach in the flood defences at Grosvenor Bridge (Berm18). Hazard ratings are shown to range across Low to Significant.

- There is flooding of Battersea Park and Clapham Junction, with hazard ratings between Low and Significant. There is also some flooding designated as Extreme at the junction between the A217 and A3208 associated with a breach at Wandsworth Bridge (Berm23).

- Flooding as a result of a breach at Bell Lane Creek (Clp01) is shown to cause flooding along the right hand side of the River Wandle and along Ram Street, with hazard rating ranging from Low to Significant.

Figure 5.9 MLWL for the Year 2100

- The extent of flooding during the 2100 climate change conditions is very similar to those modelled for the 2065 conditions, however the hazard ratings have increased throughout the flood cell.

7.3 Flooding from Rivers

7.3.1 Flood Zones

The River Wandle enters Wandsworth from the south, near Summerstown, and flows northwards through the centre of the Borough, before discharging into the River Thames. The river splits in two in the vicinity of Wandle Recreation Ground and Armoury Way, and is culverted in sections, including beneath the Southside Shopping Centre. **Appendix A Figure 5.1** shows that Wandsworth Town, King George's Park, Southfields, Earlsfield and Summerstown have areas in Flood Zone 2 and 3 associated with the River Wandle,

The River Graveney is a tributary of the River Wandle which defines the south eastern boundary of Wandsworth and joins the River Wandle to the south Wandsworth in the London Borough of Merton. It is culverted in several sections and divides in the vicinity of Tooting, where the northern boundary runs along the Wandsworth boundary before joining the River Wandle. **Appendix A Figure 5.1** shows that areas to the south of Tooting Graveney are in Flood Zone 2 associated with the River Graveney.

The Beverley Brook flows from south to north through Putney Vale, to the west of Roehampton and Putney Lower Common before joining the River Thames. **Appendix A Figure 5.1** shows that this is right on the borough boundary and there is very little area within the Borough defined as Flood Zone 2 and 3 associated with the Beverley Brook.

7.3.2 Functional Floodplain

The Functional Floodplain is defined in the NPPF as 'land where water has to flow or be stored in times of flood'. The Functional Floodplain (also referred to as Flood Zone 3b), is not separately distinguished from Flood Zone 3a on the Environment Agency Flood Map for Planning (Rivers and Sea). Rather the SFRA is the place where LPAs should identify areas of Functional Floodplain in discussion with the Environment Agency.

The NPPG states that the identification of Functional Floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1%

annual probability) flood, should provide a starting point for consideration and discussions to identify the Functional Floodplain.

Modelled outlines for the 5% AEP event for the River Wandle, River Graveney and Beverley Brook have been used by London Borough of Wandsworth to define Functional Floodplain associated with these watercourses. The modelling shows that these watercourses largely remain 'in bank' during the 5% AEP modelled event, and no alterations to these outlines are proposed by the London Borough of Wandsworth.

The outline of Flood Zone 3b Functional Floodplain for the London Borough of Wandsworth and has been mapped in **Appendix A Figure 5.1**.

7.3.3 Historic Records

Of the records of flooding provided by the stakeholders as part of the Level 1 SFRA, there are two records of fluvial flooding. These records are shown in **Appendix A Figure 5.1** and are associated with the River Wandle near Earlsfield railway station, and the River Graveney near the borough boundary in Tooting Graveney.

7.3.4 Climate Change

Appendix A Figure 5.1 includes the modelled outline for the River Wandle, River Graveney and Beverley Brook for the 1% AEP event including an allowance for climate change. As described in Section 3.2.5, this is generated by considering an increase in peak flow as a result of the anticipated effects of climate change. These modelled scenarios also include the presence of flood defences along the watercourses.

The results show a significant increase in the flood extent associated with the River Wandle through Southfields and King George's Park.

There is a slight increase in the flood extent associated with the River Graveney in Tooting Graveney, and very minimal increase associated with the Beverley Brook.

7.3.5 Ordinary Watercourses

There are a number of ordinary watercourses in the Borough which are tributaries of the main rivers, as shown in **Appendix A Figure 5.1**. The majority of the ordinary watercourses are located in the Putney Heath and Putney Vale area in the southwest of the borough, and are tributaries of the Beverley Brook. A further ordinary watercourse is located in the Summertown area and is a tributary of the River Wandle. The head of the watercourse is located in the vicinity of Lambeth Cemetery and flows northwest through Summerstown to discharge to the River Wandle northwest of Garratt Park; the watercourse is culverted between Wimbledon Road and the River Wandle.

Within Wandsworth, 1.9km of ordinary watercourse is culverted. Trash screens at the entrances to culverts and culverts themselves have the potential to become blocked by items such as plant debris and rubbish. Blockages can restrict the natural flow of water, increasing the chance of water flowing out of bank and causing local flooding due to the reduced conveyance potential of the associated watercourse. The risk of flooding from ordinary watercourses can therefore be very localised. Effective management is dependent on adopting appropriate inspection and maintenance regimes to ensure this risk is minimised where possible. Within Wandsworth, the most significant risk from culverted ordinary watercourses is in Summerstown in the vicinity of Lambeth Cemetery. London Borough of Lambeth Council own and maintain the ordinary watercourses within Lambeth Cemetery.

The maintenance of ordinary watercourses that are not owned by the LLFA is the responsibility of the riparian owner. Further details of the responsibilities of the riparian owners are stated in the LFRMS for London Borough of Wandsworth.

There are no historic recorded incidents of ordinary watercourse flooding within Wandsworth. Often, where blocked ditches or streams have been reported as being the cause of flooding this has been reported as occurring with other sources, e.g. sewer or surface water runoff, and therefore will have been reported as multiple sources of flooding in the dataset.

No modelling of the flood risk from ordinary watercourses has been undertaken to date across Wandsworth. Therefore future flood risk is based on the potential risk that might arise based on knowledge of know flooding hotspots and potential mechanisms for flooding.

7.3.6 Flood Defences

Extracts from the Environment Agency Asset Information Management System (AIMS) included in **Appendix A Figure 5.1 Inset Maps** show that the River Wandle is protected by high ground for most of its course throughout London Borough of Wandsworth. There is a culverted section beneath the shopping centre in Wandsworth Town and the upstream extent north of Wandsworth High Street as well as the Bell Lane Creek are defended by flood defence walls which form part of the Thames Tidal Defence (TTD) system.

7.3.7 Flood Warning Areas

There are 7 Environment Agency Flood Warning Areas in Wandsworth; 3 for tidal flooding associated with the River Thames, and 4 for fluvial flooding. These are identified in **Appendix A Figure 5.6**, as follows:

- Tidal Thames from Putney Bridge to Mortlake High Street East
- Tidal Thames from Wandsworth Bridge to Putney Bridge
- Tidal Thames from Deptford Creek to Wandsworth Bridge
- River Wandle at Wandsworth
- River Wandle at Wimbledon
- River Graveney at Tooting and Colliers Wood
- Beverley Brook at Wimbledon Common and Richmond Park

7.3.8 Emergency Rest Centres

Designated emergency rest centres for London Borough of Wandsworth are mapped in **Appendix A Figure 5.1** and summarised in Table 7-3.

Table 7-3 Emergency Rest Centres in Wandsworth

Rest Centre	Address	Post Code	Easting	Northing
Ackroydon Hall	26 Montfort Place	SW19 6QL	523912	173494
Alton Community Hall	1 Petersfield Rise	SW15 4AE	522524	173482
Ashburton Youth Office	Westleigh Avenue	SW15 6XD	523027	174503
Derinton Road Clubroom	101a/b Derinton Road	SW17 8HZ	527978	171855
Devas Youth Club	2A Stormont Road	SW11 5EN	528147	175606
Dimson Lodge	141 Battersea Church Road	SW11 3NR	526881	176870
Roehampton Library	2 Danebury Avenue	SW15 4HD	522250	173780
Salvation Army Congress Hall	38 Balham High Road	SW12 9AH	528714	173719
Kambala Clubroom	125 Fawcett Close	SW11 2LU	526989	176053
York Gardens Library	34 Lavender Road	SW11 2UG	526671	175816
The Venue (aka Park Court Clubroom)	Battersea Park Road	SW11 4LE	528620	176796
Wilditch Community Centre	48 Culvert Road	SW11 5BB	527925	176360
Northcote Library	155e Northcote Road	SW11 6HW	527638	174504
Balham Library	16 Ramsden Road	SW12 8QY	528512	173445
Dryburgh Hall (Putney Leisure Centre)	Dryburgh Road	SW15 1BL	523138	175375
Putney Library	5/7 Disraeli Road	SW15 2DR	524033	175149
Focus Hall Clubroom	Minstead Gardens	SW15 4EB	521725	173874
Roehampton Sport & Fitness Centre	Laverstoke Gardens	SW15 4JB	522168	173716
Lola Jones Hall & Tooting Leisure Centre	Greaves Place	SW17 0NE	527041	171597

Rest Centre	Address	Post Code	Easting	Northing
Earlsfield Library	276 Magdalen Road	SW18 3NY	526117	173051
Wandle Recreation Centre	Mapleton Road	SW18 4DN	525673	174198
Southfields Library	300 Wimbledon Park Road	SW19 6NL	524588	173139
R.O.S.E. (Residents of Savona Estate)	Ascalon Street	SW8 4DL	529095	177016
Manresa Pensioners Clubroom	Fontley Way	SW15 4LY	522272	173493
Ashburton Sheltered Housing Clubroom	280-308 Cortis Road	SW15 6XQ	523211	174403
Carey Gardens Clubroom	234 Carey Gardens	SW8 4HW	529507	176670
Pearson House Clubroom	Horne Way	SW15 1HY	523242	176173
Latchmere Leisure Centre	Burns Road	SW11 5AD	527618	176267

7.4 Flooding from Surface Water

7.4.1 Historic Records

London Borough of Wandsworth has experienced a number of surface water flood events, the most notable of which was the 20th July 2007 where intense periods of rainfall caused flash floods and the capacity of the existing drainage system to be exceeded in several locations across the Borough. This caused overland flow and ponding in low-lying areas and impacted residents, businesses and the transport network across the Borough. Table 7-4 provides an overview of other surface water flooding events that have occurred in London Borough of Wandsworth.

Table 7-4 Past surface water flood events, SWMP

Flood Event*	Description
7th August 2002 *(Source unknown)*	• Flooding incidents were recorded by the London Fire Brigade across the London Borough of Wandsworth. The exact source of these incidents in unknown.
20th July 2007 *(Surface water)*	• Intense periods of rainfall caused flash floods and the capacity of the existing drainage system to be exceeded in several locations across the Borough. This caused overland flow and ponding in low lying areas and impacted residents, businesses and the Council. The equivalent of three months of rain fell in just two hours. • London Underground records report Tooting Bec (3.5 hours) and Tooting Broadway (8 hours) railway stations being closed due to flooding during 20th July 2007. • The Council depot site containing technical services equipment flooded with around 18 inches of flood water at the gate running up close to council buildings. Damage was incurred to council equipment and vehicles. • The emergency response centre took over 400 calls from the public. • The total costs of repairs for the Council amounted to over £400,000, much of which was covered by insurance. Schools, public buildings, residential properties and the transport network, and council vehicles all suffered damage.
20th July 2009 *(Surface water)*	• Heavy rainfall event reported to have impacted the London Borough of Wandsworth. Southside Shopping Centre in Wandsworth and South Thames College were evacuated, with significant disruptions to transport and other damage caused, as a result of torrential downpours.

Regular Flooding *(Surface Water)*	• Runoff from the highway onto the railway track between Clapham Junction and Battersea Rise stations causes surface water flooding (Network Rail)
	• Three foot of flooding has been recorded at Armoury Way (junction with Wandsworth Plain) during heavy rainfall.
	• 300mm flooding has been recorded at Frogmore during heavy rainfall.
	• Gullies can become blocked providing insufficient capacity for surface water along Latchmere Road (under rail bridge).
	• Putney Bridge Road (under rail bridge near Point Pleasant) frequently floods (up to 1.5m) during rainfall events.
	• Surface water ponding during heavy rainfall has been reported by Wandsworth Borough Council at:
	  • Siward Road / Maskell Road area
	  • Stag Lane (underpass)
	  • Summerstown (junction with Wimbledon Road)
	  • Swandon Way (under rail bridge)
	• Underpasses throughout the Borough are prone to flooding due to insufficient gully capacity

Regular Flooding *(Combined Sources)*	• Surface water ponding and potential backing up of sewers during heavy rainfall have been reported by Wandsworth Borough Council at:
	  • Battersea Park Road
	  • Battersea Rise (junction with Northcote Road)
	  • Besley Street
	  • Northcote Road
	• Back up of sewers during heavy rainfall can cause flooding along Latchmere Road.
	• Surface water ponding and potential fluvial flooding from River Graveney during heavy rainfall have been reported by Wandsworth Borough Council along Kenlor Road.
	• Surface water ponding and potential fluvial flooding from River Wandle during heavy rainfall have been reported in the Wandle Valley.

*Notes: * Where the source of flooding is known this has been indicated*

As part of the SWMP for London Borough of Wandsworth, 11 CDAs were identified across the Borough, as presented in Table 7-5.

Table 7-5 SWMP CDAs in London Borough of Wandsworth

CDA ID	CDA Name
Group7_014	Putney Heath
Group7_015	King Georges Park
Group7_016	Trinity Road
Group7_017	St Georges Hospital
Group7_018	Summerstown
Group7_019	Earlsfield
Group7_020	South Balham
Group7_021	Clapham Junction South
Group7_022	Clapham Junction
Group7_023	Lavender Hill
Group7_024	Tooting Bec

A large part of the surface water flooding that takes place in London Borough of Wandsworth occurs along the route of the 'lost' Falcon Brook, which runs north to south through the east of the Borough (Group7_022 (Clapham Junction) CDA). Significant ponding of surface water is shown to impact Summerstown, Nine Elms, Lavender Hill, Earlsfield, Balham and St. George's Hospital, with the Falcon Road (Clapham Junction area), South Balham and Lavender Hill areas

historically flooded during heavier rainfall events. The Falcon Road, Tooting Bec and Nine Elms areas are impacted from upstream surface water flows from neighbouring London Borough of Lambeth.

7.4.2 Updated Flood Map for Surface Water

The recorded incidents of surface water flooding held by London Borough of Wandsworth are supported by the updated Flood Map for Surface Water (uFMfSW). The mapping is included in **Appendix A Figure 5.2** and shows that there is high probability of flooding along Northcote Road (B226) and Oldridge Road in the east of the Borough, as well as throughout Clapham adjacent to the railway lines and along the course of the former Falcon Brook in Battersea. The mapping shows a large area of flooding in King George's Park where the topography is low, and in the north of Putney in the west of the Borough.

As part of the Level 1 SFRA, Drainage Catchments (DCs) have been determined across the London Borough of Wandsworth in order to better understand and manage the risk from surface water flooding. Drainage catchments outline the area of the land that influences the surface water drainage at a certain point. The DCs are based on the natural catchments and watersheds provided within the Flood Estimation Handbook CD-ROM which have then been amended using local knowledge to account for significant infrastructure within the study area that could impact on drainage such as railway lines. It is intended that these DCs will be useful for identifying the natural drainage patterns in the local area when considering new development and future regeneration in the study area.

20 Drainage Catchments (DC) have been identified in Wandsworth, as shown in **Appendix A Figure 5.3**.

7.5 Flooding from Groundwater

7.5.1 Historic Records

There have been 52 records of reported historic flooding from groundwater (**Appendix A Figure 5.4**). Instances of groundwater flooding have been reported in a number of areas in Wandsworth, with the majority clustering in the areas of Putney, south east of Wandsworth Town, Balham, Battersea and Upper Tooting.

As noted in the SWMP for London Borough of Wandsworth, the historical records show that many of the reported incidents refer to the flooding of cellars / basements, which is a common outcome of a rising water table following a period of heavy or consistent rainfall, particularly in shallow aquifers often associated with superficial deposits.

Some flooding incidents in Battersea and near Tooting Bec Common are located over the London Clay Formation, where it is overlain by Langley Silt Member, or there are no known overlying superficial deposits. The London Clay Formation is an aquiclude and does not permit groundwater flow (and the Langley Silt Member is an aquitard). Therefore based on the available information, these incidents are possibly related to poor drainage and surface water flooding i.e. they are not true groundwater flooding incidents. However, it is conceivable that a portion of the surface water is derived from springs / seepages associated with a nearby aquifer outcrop.

7.5.2 Susceptibility to Groundwater Flooding

The Susceptibility to Groundwater Flooding dataset provided by the BGS can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the ground surface.

Appendix A Figure 5.4 indicates that there is potential for groundwater flooding to occur at surface along the River Wandle corridor (Wandsworth Town southwards to Summerstown), to the west in Putney and along the Beverly Brook corridor, and to the east from Streatham Park to Balham and in Battersea.

There are areas shown to have potential for groundwater flooding to occur below ground level to the east of the River Wandle, Wandsworth Common, Clapham Common, areas of Balham, Tooting Graveney, and along the riverside of the River Thames.

Areas with limited potential for groundwater flooding to occur include to the west of Clapham Common, a corridor either side of the A214 from Wandsworth Common southwards to Upper Tooting and Furzedown, southwest of Wandsworth Town and areas within Putney Heath.

The susceptibility to groundwater flooding in the London Borough of Wandsworth may change as a result of climate change, or changes to water management. One of the climate change predictions includes an increase of high rainfall events. This could lead to further groundwater flooding in the study area due to increased perched groundwater levels and associated spring flows. It is also noted that a shift in drainage policy, with increased infiltration SUDS, may also

lead to increased incidents of groundwater flooding. The small perched superficial deposit aquifers will be sensitive to increased recharge due to their limited storage capacity.

7.6 Flooding from Sewers

7.6.1 Historic Records

As part of the SWMP, TWUL provided information (through their DG5 register[24]) on the total number of properties affected by and at risk of sewer flooding (both internally and externally) based on historic flooding over the previous 10 years. The information presented within the SWMP highlights the wards of Balham, Thamesfield, and Latchmere as having experienced a greater number of sewer flooding incidents than the rest of the Borough.

Appendix A Figure 5.5 shows the DG5 Register that has been supplied by TWUL for the SFRA. It should be noted that TWUL focus their efforts on removing properties from the DG5 register and therefore this information may not accurately represent those properties currently at risk.

7.6.2 Climate Change

Climate change is anticipated to increase the potential risk from sewer flooding as summer storms become more intense and winter storms more prolonged. This combination is likely to increase the pressure on the existing efficiency of sewer systems, thereby reducing their design standard and leading to more frequent localised flooding incidents.

TWUL will monitor the risk of sewer flooding and put plans in place to manage this, as required, based on their business plan and priorities. London Borough of Wandsworth will work with TWUL to identify flooding hotspots and locations of known sewer capacity issues where risk could be exacerbated.

TWUL will prioritise investment for potential flood alleviation schemes depending on the severity and frequency of flooding, but this can only be identified where affected property owners report the incident to the water company.

7.7 Flooding from Other Sources

7.7.1 Risk of Flooding from Reservoirs

There have been no recorded incidents of reservoir flooding within London Borough of Wandsworth. The Environment Agency Flood Risk from Reservoirs mapping available online identifies that if Wimbledon Park Lake were to fail there is the potential for wide-scale flooding downstream. Flood waters would flow north-east from Wimbledon Park Lake into the River Wandle and into the London Borough of Wandsworth, and subsequently northwards towards the River Thames.

Table 7-6 Areas at risk of flooding from reservoirs

Name	Owner	Local Authority	Grid Ref	Areas affected
Wimbledon Park Lake	London Borough of Merton	London Borough of Merton	524874, 172403	Drains north east towards Durnsford Road and Earlsfield. Follows the course of the River Wandle into King George's Park in London Borough of Wandsworth.

Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers on a yearly basis. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency are responsible for ensuring that reservoirs are inspected regularly and essential safety work is carried out. As the undertaker for Wimbledon Park Lake, London Borough of Merton Council is required to ensure that inspections are carried out by a qualified panel engineer and that necessary safety work is completed as required to reduce the likelihood of any failure.

7.7.2 Artificial sources

Additional waterbodies in the borough include lakes and ponds in Battersea Park, Clapham Common, Wandsworth Common, Roehampton Golf Course, Tooting Bec Common, Tooting Graveney Common, King Georges Park and Roehampton University. These are however smaller in volume and therefore are not classified as reservoirs.

7.8 Summary of Flood Risk in London Borough of Wandsworth

Table 7-7 provides a summary of the number of residential, non-residential and unclassified properties within each flood zone, and Table 7-7 provides a summary of the number of properties which intersect with the Low, Medium and High designations within the uFMfSW. The property counts have been provided by Drainage Catchment (as shown in **Appendix A Figure 5.3**).

Table 7-7 Properties at risk of fluvial flooding in London Borough of Wandsworth by Drainage Catchment

Drainage Catchment	Flood Zone 1			Flood Zone 2			Flood Zone 3a			Flood Zone 3b		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC1	0	0	1	0	0	0	15,376	1,066	898	0	0	0
DC2	0	1	4	161	2	17	7,054	365	405	0	0	0
DC3	3,760	449	215	421	7	30	495	115	30	0	0	1
DC4	13,530	270	928	45	0	2	360	6	16	0	0	2
DC5	6,861	371	374	0	0	0	2	0	0	0	0	0
DC6	10,008	353	496	1132	104	70	350	204	37	0	1	4
DC7	7,720	163	265	2,188	330	132	256	116	58	0	6	4
DC8	3,048	106	168	210	16	10	0	0	0	0	0	0
DC9	2,053	101	167	0	0	0	0	0	0	0	0	0
DC10	14,679	890	461	0	0	0	0	0	0	0	0	0
DC11	5,605	367	161	23	3	1	3,943	250	211	0	0	0
DC12	1,040	5	19	0	0	0	0	0	0	0	0	0
DC13	13,054	350	354	0	0	0	0	0	0	0	0	0
DC14	12,511	372	536	278	31	56	321	94	67	0	0	1
DC15	0	0	1	0	1	2	0	0	0	0	0	0
DC16	4273	73	93	742	0	0	34	1	2	0	0	1
DC22	5,826	129	136	63	0	7	44	2	1	1	0	4
TOTAL	**103,968**	**4,000**	**4,379**	**5,263**	**494**	**327**	**28,235**	**2,219**	**1,725**	**1**	**7**	**17**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the Flood Zones. Where properties intersect two Flood Zones, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [1]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[1] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

Table 7-8 Properties at risk of surface water flooding in London Borough of Wandsworth by Drainage Catchment

Drainage Catchment	uFMfSW Low			uFMfSW Medium			uFMfSW High		
	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified	Residential	Non-residential	Unclassified
DC1	4,766	238	242	1,338	108	84	528	83	21
DC2	3,325	102	95	837	19	38	337	28	13
DC3	1,238	200	66	495	49	23	45	23	7
DC4	3,258	63	194	1,086	28	60	1,150	42	57
DC5	1,491	159	73	738	55	29	593	13	26
DC6	3,059	156	157	802	181	33	485	38	18
DC7	2,500	227	107	598	71	45	460	78	39
DC8	791	46	41	270	23	17	51	8	10
DC9	496	19	29	61	2	3	0	0	4
DC10	3,149	208	114	1,229	150	45	563	50	18
DC11	3,524	175	138	898	45	33	314	139	22
DC12	137	1	0	129	1	0	133	0	3
DC13	2,934	119	76	593	26	20	853	18	14
DC14	3,764	191	213	777	95	79	426	55	46
DC15	0	0	0	0	0	0	0	0	2
DC16	1,380	13	13	308	1	3	161	2	7
DC22	1,583	56	43	334	18	17	190	5	10
TOTAL	**37,395**	**1,973**	**1,601**	**10,493**	**872**	**529**	**6,289**	**582**	**317**

Notes: The property counts are generated by calculating the number of properties that intersect with each of the categories within the uFMfSW. Where properties intersect two or three categories from the uFMfSW, the property has been counted in the category of greatest risk. Counts have been provided by Drainage Catchment.
Ordnance Survey MasterMap was used to provide a dataset of all the buildings in the study area. Polygons with feature codes 10021, 10062, 10185 and 10187 were classified as buildings. The number of addresses located at basement or ground floor level associated with each OSMM building polygon was determined using the Environment Agency National Receptor Database (NRD). The NRD was also used to determine the use of the property, based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual [2]. These have been grouped into three categories; Residential, Non-Residential, Unclassified.

[2] Flood Hazard Research Centre, 2010, Multi-Coloured Manual - 2010

8 Guidance for the application of the Sequential Test

8.1 Sequential Approach

The sequential approach is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to sites at higher risk. This will help avoid the development of sites that are inappropriate on flood risk grounds. The subsequent application of the Exception Test, where required, will ensure that new developments in areas of particular flood risk will only occur where flood risk is clearly outweighed by other sustainability drivers and will ensure that development can be made safe from flooding and not increase flood risk elsewhere.

The sequential approach can be applied at all levels and scales of the planning process, both for sites between flood zones and where a site has to be located in a higher risk zone, within the extent of that flood zone by locating the more vulnerable elements of the development in the areas of lowest risk. All opportunities to locate new developments in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

8.2 Applying the Sequential Test – Plan-Making

Each LPA must demonstrate that it has considered a range of possible sites in conjunction with the flood zone and vulnerability information from the Level 1 SFRA and applied the Sequential Test, and where necessary, the Exception Test (Level 2 SFRA), in the site allocation process.

Table 8-1 shows the flood risk definitions for all sources of flooding and should be used to inform the Sequential Test. Figure 8-1 illustrates the approach for applying the Sequential Test for sites without tidal flood defences, which the London Boroughs of Croydon, Merton and Sutton should adopt in the allocation of sites as part of the preparation of the Local Plan. Figure 8-2 illustrates the approach for applying the Sequential Test for sites with existing tidal flood defences, which the London Borough of Wandsworth should adopt in the allocation of sites as part of the preparation of the Local Plan.

The Sequential Test should be undertaken by each London Borough and accurately documented to ensure decision making processes are consistent and transparent.

Table 8-1 Flood Risk Definitions for Sequential Test

Risk	Fluvial / Tidal Flood Zone	Other Sources of Flood Risk			
		Surface Water	Groundwater	Sewer Consideration	Reservoir
Low	Flood Zone 1	uFMfSW Very Low	"Not considered to be at risk of groundwater flooding" OR "Limited potential for groundwater flooding"	TWUL to assess the sewer network for each site	Use EA Flooding from Reservoirs map
Medium	Flood Zone 2	uFMfSW Low to Medium	"Potential for groundwater flooding of property below ground surface" OR "Potential for groundwater flooding at surface"		N/A
High	Flood Zone 3a	uFMfSW High	Historic records of groundwater flooding		N/A
Very High	Flood Zone 3b	N/A	N/A		N/A

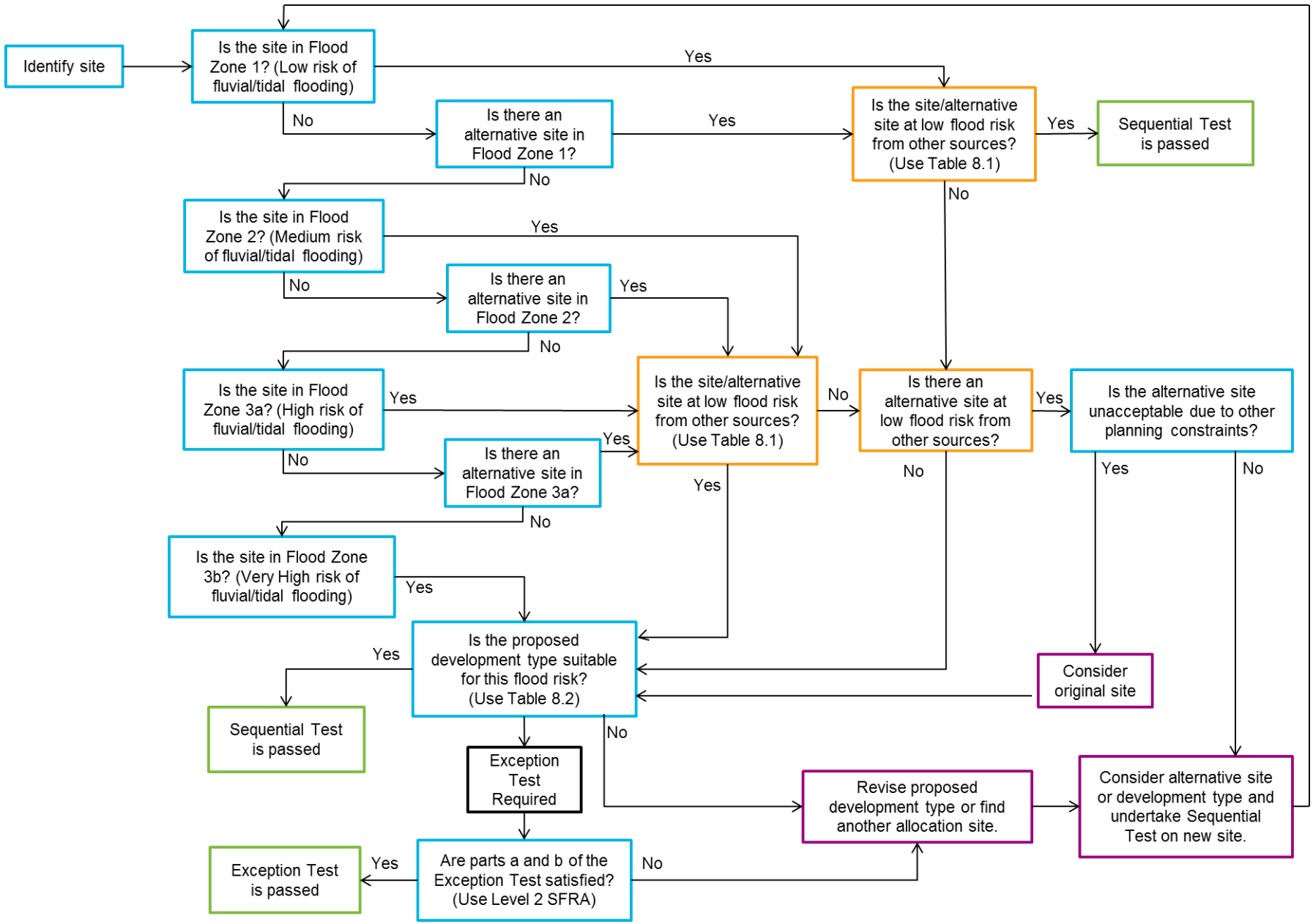


Figure 8-1 Application of Sequential Test for Local Plan preparation – Undefended sites

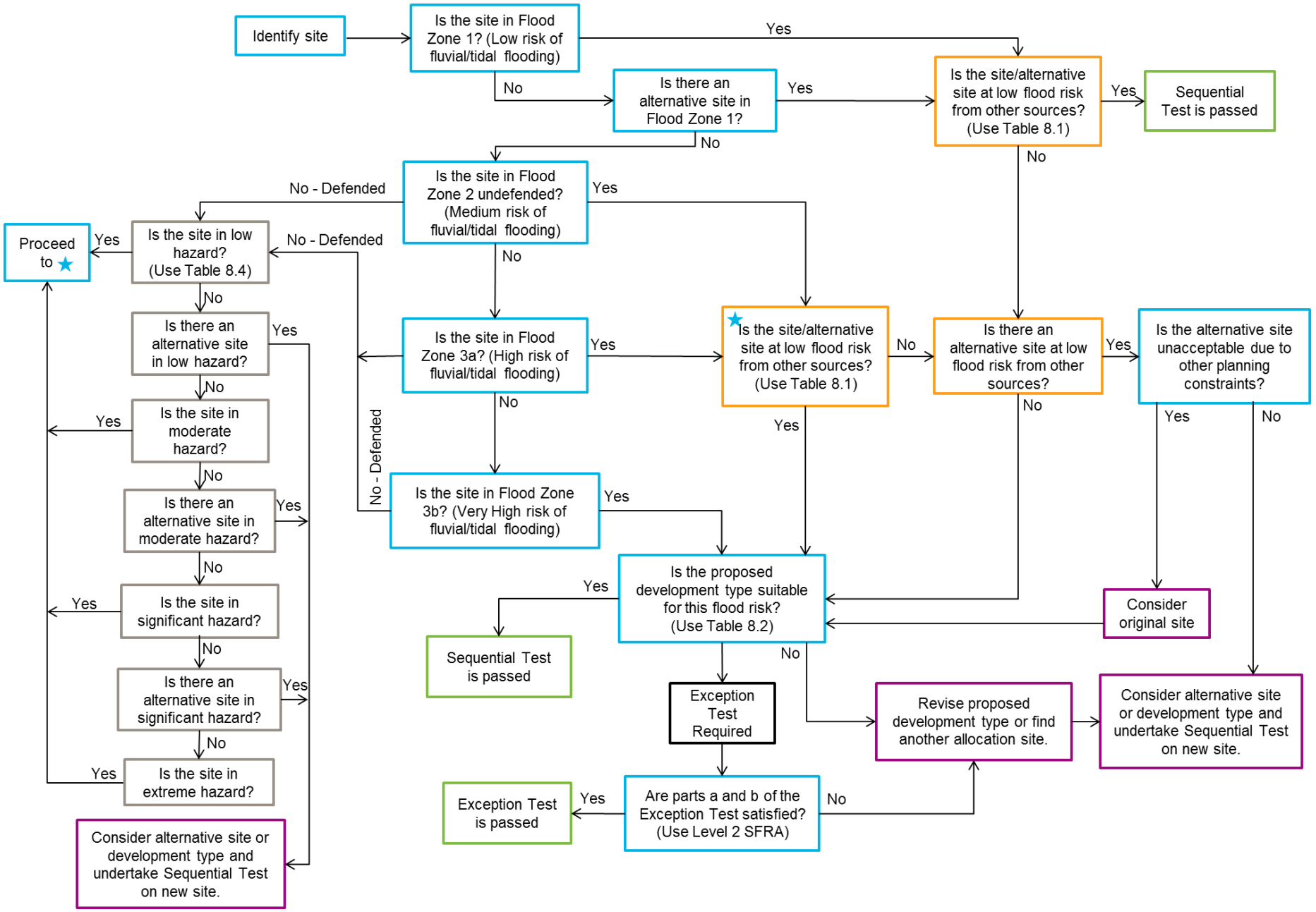


Figure 8-2 Application of Sequential Test for Local Plan preparation – Tidal defended sites

The Sequential Test requires an understanding of the flood zones in the study area and the vulnerability classification of the proposed developments. Flood zone definitions are provided in Table 3-2 and mapped in Appendix A Figure 2.1, Figure 3.1, Figure 4.1 and Figure 5.1 (and the Flood Map for Planning (Rivers and Sea) on the Environment Agency website). Flood risk vulnerability classifications, as defined in the PPG, are presented in Table 8-2.

Table 8-2 Flood Risk Vulnerability Classification (PPG, 2014)

Essential Infrastructure	• • •
Highly Vulnerable	• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”).
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • 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. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water Compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • MOD defence installations. • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

The NPPF acknowledges that some areas will (also) be at risk of flooding from sources other than fluvial. All sources must be considered when planning for new development including: flooding from land or surface water runoff; groundwater; sewers; and artificial sources.

If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

The recommended steps in undertaking the Sequential Test are detailed below. This is based on the flood zone and flood risk vulnerability and is summarised in Table 8-3. Table 8-3 indicates the compatibility of different development types with the flood zones.

Table 8-3 Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPG, 2014)

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3a	Exception Test Required	✓	×	Exception Test Required	✓
	3b	Exception Test Required	✓	×	×	×

✓ - Development is appropriate × - Development should not be permitted

8.2.1 Stages for LPA application of the Sequential Test in Plan-Making

The information required to address many of these steps is provided in the accompanying GIS layers and maps presented in Appendix A.

1. Assign potential developments with a vulnerability classification (Table 8-2). Where development is mixed, the development should be assigned the highest vulnerability class of the developments proposed.
2. The location and identification of potential development should be recorded.
3. The flood zone classification of potential development sites should be determined based on a review of the Flood Map for Planning (Rivers and Sea). Where these span more than one flood zone, all flood zones should be noted.
4. Identify existing flood defences serving the potential development sites. (However, it should be noted that for the purposes of the Sequential Test, flood zones ignoring defences should be used).
5. The design life of the development should be considered with respect to climate change:
    - 100 years – up to 2115 for residential developments; and
    - Design life for commercial / industrial developments will be variable, however at least a 60 year design life[36] should be assumed for such development, unless demonstrated otherwise.
6. Highly Vulnerable developments to be accommodated within the LPA area should be located in those sites identified as being within Flood Zone 1. If these cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1, sites in Flood Zone 2 can then be considered. Highly Vulnerable developments in Flood Zone 2 will require application of the Exception Test. If sites in Flood Zone 2 are inadequate then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area. Within each flood zone Highly Vulnerable development should be directed, where possible, to the areas at lowest risk from all sources of flooding. It should be noted that Highly Vulnerable development is not appropriate in Flood Zones 3a and 3b.
7. Once all Highly Vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as More Vulnerable. In the first instance More Vulnerable development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to

[36] Mayor of London, 2014, Sustainable Design and Construction SPG, London Plan 2011 Implementation Framework.

accommodate More Vulnerable development, sites in Flood Zone 3a can be considered. More Vulnerable developments in Flood Zone 3a will require application of the Exception Test. As with Highly Vulnerable development, within each flood zone More Vulnerable development should be directed to areas at lowest risk from all sources of flooding. It should be noted that More Vulnerable development is not appropriate in Flood Zone 3b.

8. Once all More Vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as Less Vulnerable. In the first instance Less Vulnerable development should be located in any remaining unallocated sites in Flood Zone 1, continuing sequentially with Flood Zone 2, then Flood Zone 3a. Less Vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
9. Essential Infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is satisfied.
10. Water Compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. The sequential approach should still be followed in the selection of sites; however it is appreciated that Water Compatible development by nature often relies on access and proximity to water bodies.
11. Where the development type is Highly Vulnerable, More Vulnerable, Less Vulnerable or Essential Infrastructure and a site is found to be impacted by a recurrent flood source (other than tidal or fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test.

8.2.2 Stages for LPA application of the Sequential Test in Plan-Making – Tidal Defended Sites

For sites that are within the tidal floodplain of the River Thames (Flood Zone 3a), but are protected by the presence of tidal defences, it is recommended that the London Borough of Wandsworth use additional flood risk information to consider the variation in flood risk within the flood zone when applying the Sequential Test. In this case, the flood hazard mapping described in section 7.2.4 should be used to apply the Sequential Test to ensure that development is directed towards areas of Low hazard prior to the consideration of areas at Moderate, Significant and Extreme hazard.

8.2.3 Windfall Sites

Windfall sites are those which have not been specifically identified as available in the Local Plan process. They comprise previously-developed sites that have unexpectedly become available. In cases where development cannot be fully met through the provision of site allocations, LPAs are expected to make a realistic allowance for windfall development, based on past trends and expected future trends. It is recommended that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

8.3 Applying the Sequential Test – Individual Applications

If development is proposed in Flood Zone 2 or 3, and the Sequential Test has not already been carried out for the site for the same development type at the Local Plan level, then it is necessary to undertake a Sequential Test for the site. The Environment Agency publication 'Demonstrating the Flood Risk Sequential Test for Planning Applications'[37] sets out the procedure as follows:

a. Identify the geographical area of search over which the test is to be applied; this could be the Borough area, or a specific catchment if this is appropriate and justification is provided (e.g. school catchment area or the need for affordable housing within a specific area identified for regeneration in Local Plan policies).
b. Identify the source of 'reasonably available' alternative sites; usually drawn from evidence base / background documents produced to inform the Local Plan.
c. State the method used for comparing flood risk between sites; for example the Environment Agency Flood Map for Planning, the SFRA mapping, site-specific FRAs if appropriate, other mapping of flood sources.
d. Apply the Sequential Test; systematically consider each of the available sites, indicate whether the flood risk is higher or lower than the application site, state whether the alternative option being considered is allocated in the Local Plan, identify the capacity of each alternative site, and detail any constraints to the delivery of the alternative site(s).
e. Conclude whether there are any reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
f. Where necessary, as indicated by Table 8-3, apply the Exception Test.
g. Apply the Sequential approach to locating development within the site.

[37] Environment Agency, April 2012, 'Demonstrating the flood risk Sequential Test for Planning Applications', Version 3.1

It should be noted that it is for LPAs, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular circumstances in any given case. The developer should justify with evidence to the LPA what area of search has been used when making the application. Ultimately the LPA needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere.

8.3.1 Sequential Test Exemptions

It should be noted that the Sequential Test does not need to be applied in the following circumstances:

- Individual developments proposed on sites which have been allocated in development plans through the Sequential Test.
- Minor development, which is defined in the NPPF as:
    - minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m^2;
    - alterations: development that does not increase the size of buildings e.g. alterations to external appearance;
    - householder development: for example; sheds, garages, games rooms etc. within the curtilage of the existing dwelling , in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats;
- Change of Use applications, unless it is for a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site;
- Development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea) unless the SFRA, or other more recent information, indicates there may be flooding issues now or in the future (for example, the site was identified as being at risk of surface water or through the impact of climate change);
- Redevelopment of existing properties (e.g. replacement dwellings), provided they do not increase the number of dwellings in an area of flood risk (i.e. replacing a single dwelling with an apartment block).

8.4 Exception Test

The purpose of the Exception Test is to ensure that where it may be necessary to locate development in areas at risk of flooding, new development is only permitted in Flood Zone 2 and Flood Zone 3 where the flood risk is clearly outweighed by other sustainability factors and where the development will be safe during its lifetime, considering climate change.

The NPPF states that for the Exception Test to be passed:

- *Part 1 - "It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared; and*
- *Part 2 - A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."*

Both elements of the test will have to be passed for development to be allocated or permitted.

In order to determine Part 1) of the Exception Test, applicants should assess their scheme against the objectives set out in the LPA's Sustainability Appraisal. The objectives for each Borough have been set out in Appendix B Tables B-1 – B-4.

In order to demonstrate satisfaction of Part 2) of the Exception Test, relevant measures, such as those presented within Section 9 should be applied and demonstrated within a site-specific FRA (as detailed in Section 11).

9 Guidance for Managing and Mitigating Flood Risk

9.1 Overview

The NPPF appreciates that it may not always be possible to avoid locating development in areas at risk of flooding. This Section provides guidance on the range of measures that could be considered in order to manage and mitigate flood risk. These measures should be considered when preparing a site-specific FRA as described in Section 11.

It is essential that the development control process influencing the design of future development within the study area carefully mitigates the potential impact that climate change may have upon the risk of flooding. As a result mitigation measures should be designed with an allowance for climate change over the lifetime of proposed development as follows:

- 100 years (up to 2115) for residential developments; and
- 75 years (up to 2090) for commercial / industrial developments, or other time horizon specific to the non-residential use proposed.

9.2 Development Layout and Sequential Approach

A sequential approach to site planning should be applied within new development sites.

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding. The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas (considering all sources of flooding) e.g. residential elements should be restricted to areas at lower probability of flooding whereas parking, open space or proposed landscaped areas can be placed on lower ground where there may be a higher probability of flooding. Finished Floor Levels

9.2.1 Fluvial risk in Wandsworth, Merton, Sutton and Croydon

All More Vulnerable and Highly Vulnerable development within Flood Zones 2 and 3 should set Finished Floor Levels a minimum of 300mm above the known or modelled 1 in 100 annual probability (1% AEP) flood level including an allowance for climate change.

Where developing in Flood Zone 2 and 3 is unavoidable, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) and Highly Vulnerable land uses, is to ensure internal floor levels are raised a freeboard level above the design flood level.

In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Environment Agency and/or the LPA should be approached to discuss options for a reduction in the minimum internal ground floor levels provided flood resistance measures are implemented up to an agreed level. There are also circumstances where flood resilience measures should be considered first, these are described further below. For both Less and More Vulnerable developments where internal access to higher floors is required, the associated plans showing the access routes and floor levels should be included within any site-specific FRA. Table 9-1 provides an overview of the requirements for finished floor levels in areas of at risk of fluvial flooding.

Table 9-1 Finished Floor Levels for fluvial flood risk areas

Development Type	Flood Zone 3	Flood Zone 2
Minor development (i.e. non-residential extensions with a floor space <250m^2 and householder developments)	Provide evidence to the London Borough Council that EITHER, Floor levels within the proposed development will be set no lower than existing levels AND, flood proofing of the proposed development has been incorporated where appropriate. Details of flood proofing / resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' CLG (2007). OR, Floor levels within the extension will be set 300mm above the known or modelled 1 in 100 annual probability river flood (1%) in any year including climate change. This flood level is the extent of the Flood Zones. Applicants should provide a plan showing floor levels relative to flood levels. All levels should be stated in relation to Ordnance Datum.	Provide evidence to the London Borough Council that, Floor levels within the proposed development will be set no lower than existing levels AND, flood proofing of the proposed development has been incorporated where appropriate. Details of flood proofing / resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' CLG (2007).
New residential development (More Vulnerable)	Where appropriate, subject to there being no other planning constraints (e.g. restrictions on building heights), finished floor levels should be set a minimum of 300mm above the 1% annual probability flood level (1 in 100 year) including climate change. The design flood level should be derived for the immediate vicinity of the site (i.e. relative to the extent of a site along a watercourse as flood levels are likely to vary with increasing distance downstream) as part of a site-specific FRA. Sleeping accommodation should be restricted to the first floor or above to offer the required safe place of refuge. Internal ground floors below this level could however be occupied by either Less Vulnerable commercial premises, garages or non-sleeping residential rooms (e.g. kitchen, study, lounge) (i.e. applying a sequential approach within a building).	
New non-residential development (e.g. Less Vulnerable)	Finished floor levels may not need to be raised. For example, Less Vulnerable developments can be designed to be floodable instead of raising floor levels, and this may be beneficial to help minimise the impact of the development on the displacement of floodwater and the risk of flooding to the surrounding area. However, it is strongly recommended that internal access is provided to upper floors (first floor or a mezzanine level) to provide safe refuge in a flood event (refer to Section 5.6). Such refuges will have to be permanent and accessible to all occupants and users of the site and a FWEP should be prepared to document the actions to take in the event of a flood (refer Section 5.11).	
Basements	Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not be permitted in Flood Zone 3b. Self-contained residential basements and bedrooms at basement level are not permitted in Flood Zone 3a. Internal access to a higher floor situated 300mm above the 1% annual probability flood level (1 in 100 year) including climate change must be provided for all other basements, basement extensions and conversions.	All basements, basement extensions and conversions must have internal access to a higher floor situated 300mm above the 1% annual probability flood level (1 in 100 year) including climate change.

9.2.2 Defended Tidal Floodplain (Wandsworth)

All More Vulnerable and Highly Vulnerable development within defended tidal Flood Zone 3a should set Finished Floor Levels for habitable accommodation above flood levels derived from Thames Tidal breach modelling. The lifetime of the proposed development should be considered when selecting the appropriate modelling scenario to use.

The tidal Flood Zone 3a associated with the River Thames is protected by the presence of the Thames Tidal Defences. Where development in the defended tidal Flood Zone 3a is unavoidable, the tidal breach flood modelling (described in section 7.2.4) should be used to inform the setting of finished floor levels for habitable accommodation. Table 9-2 provides an overview of the requirements for finished floor levels.

For both Less and More Vulnerable developments where internal access to higher floors is required, the associated plans showing the access routes and floor levels should be included within any site-specific FRA.

Table 9-2 Finished Floor Levels for defended tidal floodplain (Wandsworth)

Development Type	Flood Zone 3
Minor development (i.e. non-residential extensions with a floor space <250m^2 and householder developments)	Provide evidence to Wandsworth Council that EITHER, Floor levels within the proposed development will be set no lower than existing levels AND, flood proofing of the proposed development has been incorporated where appropriate. Details of flood proofing / resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' CLG (2007). OR, Floor levels within the extension will be set at or above flood levels derived from the breach modelling for the appropriate time horizon. Applicants should provide a plan showing floor levels relative to flood levels. All levels should be stated in relation to Ordnance Datum.
New residential development (More Vulnerable)	The Environment Agency tidal breach modelling may be used to inform finished floor levels for specific development sites. The appropriateness of a particular breach location should be considered in relation to the local topography and potential flow paths. If a breach analysis has been undertaken for the area, finished floor levels should be set above the flood levels derived from the breach modelling. The scenario using the Mean Likely Water Level (MLWL) including an allowance for climate change over the lifetime of the development should be used i.e. MLWL for the year 2115 for residential development. Where no breach analysis is available; finished floor levels should be set at or above the MLWL, including an allowance for climate change over the lifetime of the development, (typically 100 years for residential development). No freeboard is required as raising finished floor levels of defended properties is considered conservative enough. Sleeping accommodation should be restricted to the first floor or above to offer the required 'safe place' of refuge.
New non-residential development (e.g. Less Vulnerable)	Finished floor levels may not need to be raised. For example, Less Vulnerable developments can be designed to be floodable instead of raising floor levels, and this may be beneficial to help minimise the impact of the development on the displacement of floodwater and the risk of flooding to the surrounding area. However, it is strongly recommended that internal access is provided to upper floors (first floor or a mezzanine level) to provide safe refuge in a flood event (refer to Section 5.6). Such refuges will have to be permanent and accessible to all occupants and users of the site and a FWEP should be prepared to document the actions to take in the event of a flood (refer Section 5.11).
Basements	Self-contained residential basements and bedrooms at basement level are not permitted in Flood Zone 3a. Internal access to a higher floor situated at levels derived from the breach modelling (MLWL including an allowance for climate change over the lifetime of the development) must be provided for all other basements, basement extensions and conversions.

9.3 Flood Resistance 'Water Exclusion Strategy'

There is a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. The Department for Communities and Local Government (CLG) have published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[38], the aim of which is to provide guidance to developers and designers on how to improve the resistance and resilience of new properties to flooding through the use of suitable materials and construction details. Figure 9-1 provides a summary of the Water Exclusion Strategy (flood resistance measures) and Water Entry Strategy (flood resilience measures) which can be adopted depending on the depth of floodwater that could be experienced.

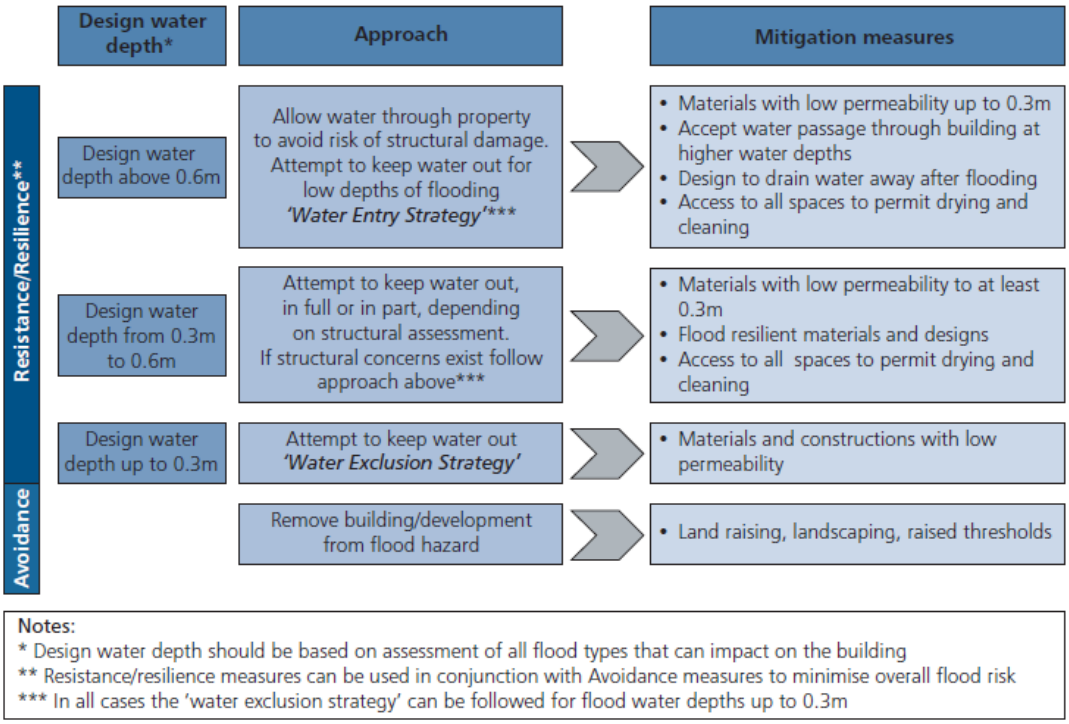


Figure 9-1 Flood Resistant / Resilient Design Strategies, Improving Flood Performance, CLG 2007

Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy); they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration, low depth flooding, i.e. less than 0.3m, although these measures should be adopted where depths are between 0.3m and 0.6m and there are no structural concerns.

In areas at risk of flooding of low depths (<0.3m), implement flood resistance measures such as:

- **Using materials and construction with low permeability.**
- **Land raising (subject to this not increasing flood risk to neighbouring properties).**
- **Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk to neighbouring properties).**
- **Raising thresholds and finished floor levels e.g. porches with higher thresholds than main entrance.**
- **Flood gates with waterproof seals.**
- **Sump and pump for floodwater to remove waste faster than it enters.**

There is a range of property flood protection devices available on the market designed specifically to resist the passage of floodwater (Figure 9-2 and Figure 9-3). These include removable flood barriers and gates designed to fit openings, vent covers and stoppers designed to fit WCs. These measures can be appropriate for preventing water entry associated with fluvial flooding as well as surface water and sewer flooding. The efficacy of such devices relies on their being deployed before a flood event occurs. It should also be borne in mind that devices such as air vent

[38] CLG (2007) *Improving the Flood Performance of New Buildings, Flood Resilient Construction*

covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.



Figure 9-2 Examples of flood barriers, air bricks and non-return valves



Figure 9-3 Example of flood gates

9.4 Flood Resilience 'Water Entry Strategy'

For flood depths greater than 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable and suitable flood warning is received.

Materials should be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively sacrificial materials can be included for internal and external finishes; for example the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 0.1m above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

In areas at risk of frequent or prolonged flooding, implement flood resilience measures such as:

- **Use materials with either, good drying and cleaning properties, or, sacrificial materials that can easily be replaced post-flood.**
- **Design for water to drain away after flooding.**
- **Design access to all spaces to permit drying and cleaning.**
- **Raise the level of electrical wiring, appliances and utility metres.**
- **Coat walls with internal cement based renders; apply tanking on the inside of all internal walls.**
- **Ground supported floors with concrete slabs coated with impermeable membrane.**
- **Tank basements, cellars or ground floors with water resistant membranes.**
- **Use plastic water resistant internal doors.**

Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[39].

9.5 Structures

Structures such as (bus, bike) shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows.

9.6 Safe Access and Egress

Safe access and egress is required to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood.

A safe access/egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area (e.g. within Flood Zone 1) using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances. This is of particular importance when contemplating development on sites within Flood Zone 1, but the surrounding area is within Flood Zone 2 or 3.

Guidance prepared by the Environment Agency[40] uses a calculation of flood hazard to determine safety in relation to flood risk. Flood hazard is a function of the flood depth and flow velocity at a particular point in the floodplain along with a suitable debris factor to account for the hazard posed by any material entrained by the floodwater. The derivation of flood hazard is based on the methodology in Flood Risks to People FD2320, the use of which for the purpose of planning and development control is clarified in the abovementioned publication. Flood hazard mapping is presented within the Level 2 SFRA.

Table 9-3 Hazard to People Rating (HR=d x (v +0.5) + DF) (Table 13.1 FD2320/TR2)

Flood Hazard (HR)	Description
Less than 0.75	Very low hazard – Caution
0.75 to 1.25	Dangerous for some – includes children, the elderly and the infirm
1.25 to 2.0	Dangerous for most – includes the general public
More than 2.0	Dangerous for all – includes the emergency services

[39] CLG, 2007, Improving the Flood Performance of New Buildings, Flood Resilient Construction. http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf?bcsi_scan_E956BCBE8ADBC89F=0&bcsi_scan_filename=flood_performance.pdf

[40] Environment Agency, HR Wallingford, May 2008, Supplementary note on Flood hazard ratings and thresholds for development planning and control purpose. Clarification of Table 13.1 FD2320/TR2 and Figure 3.2 FD2321/TR1. http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2321_7400_PR_pdf.sflb.ashx

For developments located in areas at risk of tidal and / or fluvial flooding safe access and egress must be provided for new development as follows in order of preference:

- **Safe dry route for people and vehicles.**
- **Safe dry route for people.**
- **If a dry route for people is not possible, a route for people where the flood hazard (in terms of depth and velocity of flooding) is low and should not cause risk to people.**
- **If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles. However the public should not drive vehicles in floodwater.**

For fluvial flooding, a 'dry' access/egress is a route located above the 1% annual probability flood level (1 in 100 year) including an allowance for climate change.

For developments located in areas of defended tidal floodplain (Wandsworth), a 'dry' access/egress is a route located above the breach flood level or within an area modelled as low hazard, and leads to an area of high ground outside the floodplain.

9.7 Safe Refuge

In exceptional circumstances, dry access above the 1% annual probability (1 in 100 year) flood level including climate change associated with fluvial flooding, and above the modelled breach flood levels for tidal flooding, may not be achievable. In these circumstances the Environment Agency and the LPA should be consulted to ensure that the safety of the site occupants can be satisfactorily managed. This will be informed by the type of development, the number of occupants and their vulnerability and the flood hazard along the proposed egress route. For example, this may entail the designation of a safe place of refuge on an upper floor of a building, from which the occupants can be rescued by emergency services. It should be noted that sole reliance on a safe place of refuge is a last resort, and all other possible means to evacuate the site should be considered first. Provision of a safe place of refuge will not guarantee that an application will be granted.

9.8 Floodplain Compensation Storage

All new development within Flood Zone 3 associated with fluvial watercourses must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water, and should seek opportunities to provide betterment with respect to floodplain storage.

Similarly, where ground levels are elevated to raise a development out of the fluvial floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced.

As depicted in Figure 9-4, floodplain compensation must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership and linked to the site[41]. Floodplain compensation must be considered in the context of the 1% annual probability (1 in 100 year) flood level including an allowance for climate change. When designing a scheme flood water must be able to flow in and out and must not pond. An FRA must demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[42].

[41] In hydrological connectivity.
[42] CIRIA January 2004, CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry.

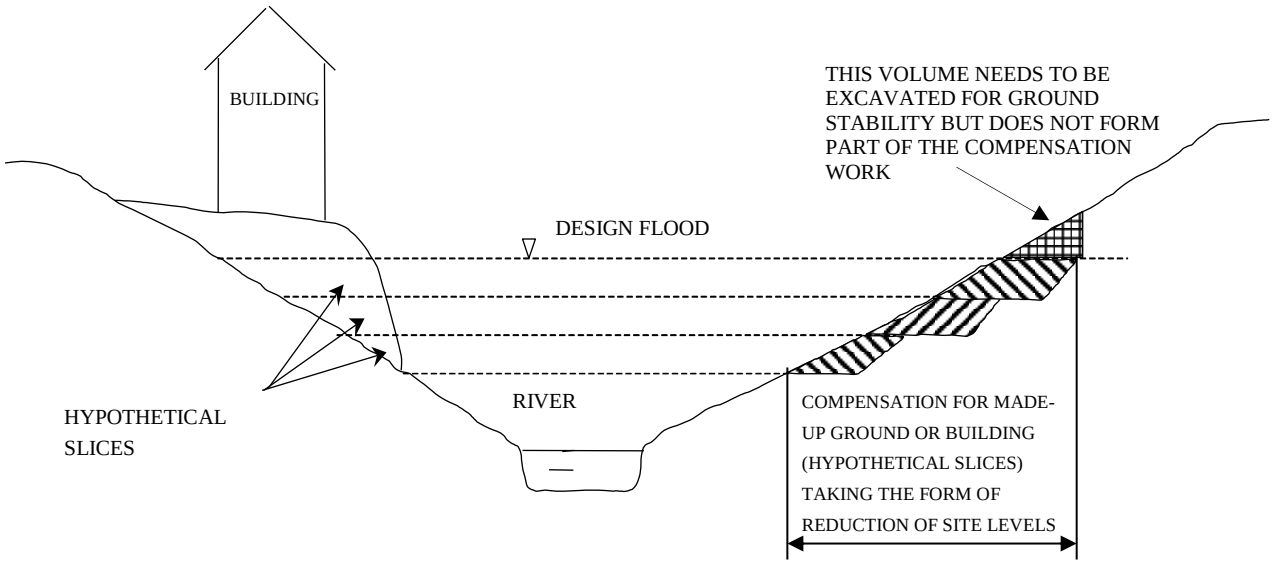


Figure 9-4 Example of Floodplain Compensation Storage (Environment Agency 2009)

The requirement for no loss of floodplain storage from the fluvial floodplain means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site, or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage.

Areas of Residual Tidal Risk

For areas within London Borough of Wandsworth at residual risk of tidal flooding, there is not usually a requirement from the Environment Agency to provide floodplain compensation storage within the defended floodplain, assuming that the defences will be maintained for the lifetime of the development. However, the impact of residual risk on other properties should be considered, and where the potential increase of flood levels or potential disruption of flow routes as a result of development is significant, compensatory flood storage should be provided.

9.9 Flood Voids

The use of under-floor voids with adequate openings beneath the raised finished floor levels can be considered for development in Flood Zone 2 and 3 associated with fluvial flooding. They are generally considered to provide indirect compensation or mitigation, but not true compensation for loss of floodplain storage. The use of under-floor voids will typically require a legal agreement or planning condition and maintenance plan for them to remain open for the lifetime of the development and agreement that the LPA will enforce. Sole reliance on the use of under-floor voids to address the loss of floodplain storage capacity is generally not acceptable on undeveloped sites or for individual properties.

Should it not be possible to achieve all the level for level compensation required, the Environment Agency may consider that the remainder be provided through the use of under-floor voids instead. The amount of level for level compensation would need to be maximised and any under-floor voids would need to be appropriately designed and kept clear to enable them to function effectively.

Ideally, void openings should be a minimum of 1m long and open from existing ground levels to at least the 1% annual probability (1 in 100 year) plus climate change flood level. By setting finished floor levels at a minimum of 300mm above the design flood level, there is usually enough space provision for voids below. There should be a minimum of 1m of open void length per 5m length of wall. Void openings should be provided along all external walls of the proposed extension. If security is an issue, 10mm diameter vertical bars set at 100mm centres can be incorporated into the void openings. The Environment Agency is likely to seek confirmation from the LPA that the voids be maintained in a free and open condition for the lifetime of the development.

9.10 Car Parks

Where car parks are specified as areas for the temporary storage of surface water and fluvial floodwaters, flood depths should not exceed 300mm given that vehicles may be moved by water of greater depths. Where greater depths are expected, car parks should be designed to prevent the vehicles from floating out of the car park. Signs should be in place to notify drivers of the susceptibility of flooding and flood warning should be available to provide sufficient time for car owners to move their vehicles if necessary.

9.11 Flood Routing

All new development in Flood Zones 2 and 3 should not adversely affect flood routing and thereby increase flood risk elsewhere. Opportunities should be sought within the site design to make space for water, such as:

- **Removing boundary walls or replacing with other boundary treatments such as hedges, fences (with gaps).**
- **Considering alternatives to solid wooden gates, or ensuring that there is a gap beneath the gates to allow the passage of floodwater.**
- **On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to river when levels recede.**
- **Create undercroft car parks or consider reducing ground floor footprint and creating an open area under the building to allow flood water storage.**
- **Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.**

In order to demonstrate that 'flood risk is not increased elsewhere', development in the floodplain will need to prove that flood routing is not adversely affected by the development, for example giving rise to backwater effects or diverting floodwaters onto other properties.

Potential overland flow paths should be determined and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere.

Careful consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

9.12 Riverside Development

Retain an 8 metre wide undeveloped buffer strip alongside Main Rivers and Ordinary Watercourses and explore opportunities for riverside restoration. For London Borough of Wandsworth, retain a 16 metre wide buffer strip alongside the Thames Tidal defence line.

New development within 8 metres of a Main River, 16 metres of the Thames Tidal defence (Wandsworth) or 8 metres of an Ordinary Watercourse will require consent from either the Environment Agency or LPA (as LLFA) respectively.

The Environment Agency would seek an 8 metre wide undeveloped buffer strip alongside main fluvial rivers for maintenance purposes, and a 16 metre wide undeveloped buffer strip alongside the Thames Tidal defence line, from the landward toe of the flood defence, measured from the rearmost extent including any ground anchors and tie rods present. The Environment Agency would also ask developers to explore opportunities for riverside restoration as part of any development.

Under Section 109 of the Water Resources Act 1991 and/or Environment Agency Byelaws, any works within 8 metres of any statutory Main River (both open channels and culverted sections) or 16 metres of a Main Tidal River requires Environment Agency consent. Whilst Flood Defence Consents are dealt with outside of the planning process, since requirements of the consenting process in relation to flood risk, biodiversity and pollution may result in changes to development proposals or construction methods, the Environment Agency aims to advise on such issues as part of its statutory consultee role in the planning process. Should proposed works not require planning permission the

Environment Agency can be consulted regarding permission to do work on or near a river, flood or sea defence by contacting enquiries@environment-agency.gov.uk

As of 6 April 2012 responsibility for the consenting of works by third parties on Ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) has transferred from the Environment Agency to the London Boroughs as LLFAs. Each London Borough is now responsible for the consenting of works to ordinary watercourses and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) within 8 metres that affect flow within the channel (such as in channel structures or diversion of watercourses). Enquiries and applications for ordinary watercourse consent should be sent to the following contact information for each London Borough Council:

LONDON BOROUGH OF CROYDON:

Please return the completed form and supporting documents to:

Email: floodandwater@croydon.gov.uk

Please send the fee and non-electronic documents to:

Ordinary Watercourse Applications
Highways
6th Floor, Zone C
Bernard Weatherill House
8 Mint Walk
Croydon CR0 1EA

General enquires: 020 8255 2864

LONDON BOROUGH OF MERTON:

Environment and Regeneration Department
London Borough of Merton
Civic Centre
London Road
Morden
SM4 5DX

Telephone: 020 8274 4901

Email: trafficandhighways@merton.gov.uk

LONDON BOROUGH OF SUTTON:

Ordinary Watercourse Consent Application
24 Denmark Road
Carshalton
Surrey
SM5 2JG

General enquiries: 020 8770 5000

Enquiries: danielle.ford@sutton.gov.uk

Website: www.sutton.gov.uk

LONDON BOROUGH OF WANDSWORTH:

Wandsworth Council
The Town Hall
Wandsworth High Street
London SW18 2PU

Reception email: enquiries@wandsworth.gov.uk

Switchboard telephone: 020 8871 6000

Consent will be refused if the works would result in an increase in flood risk, a prevention of operational access to the watercourse and/ or an unacceptable risk to nature conservation[43].

9.13 Flood Warning and Evacuation Plans

Evacuation is where flood alerts and warnings provided by the Environment Agency enable timely actions by residents or occupants to allow evacuation to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises. Rescue by the emergency services is likely to be required where flooding has occurred and prior evacuation has not been possible.

For all developments (excluding minor developments and change of use) proposed in Flood Zone 2 or 3, a Flood Warning and Evacuation Plan should be prepared to demonstrate what actions site users will take before, during and after a flood event to ensure their safety, and to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population.

For sites in Flood Zone 1 it is important to consider the surrounding area to assess the flood risk of the evacuation route and emergency vehicle access route to the site. If these routes incorporate areas in Flood Zone 2 or 3, it may also be necessary to prepare a Flood Warning and Evacuation Plan to determine potential egress routes away from the site through areas that may be at risk of flooding during the 1% annual probability (1 in 100 year) flood event including an allowance for climate change.

[43] Surrey County Council, 2012, Draft Local Flood Risk Management Strategy.

The Environment Agency has a tool on their website to create a Personal Flood Plan[44]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details. Where proposed development comprises non-residential extension <250m^2 and householder development (minor development), it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate.

Flood Warning and Evacuation Plans should include:

How flood warning is to be provided, such as:

- availability of existing flood warning systems (refer to Sections 4.2.7, 5.2.7, 6.2.7 and 7.3.7 and Figures Appendix A Figure 2.6, Figure 3.6, Figure 4.6 and Figure 5.6);
- where available, rate of onset of flooding and available flood warning time; and
- how flood warning is given.

What will be done to protect the development and contents, such as:

- How easily damaged items (including parked cars) or valuable items (important documents) will be relocated;
- How services can be switched off (gas, electricity, water supplies);
- The use of flood protection products (e.g. flood boards, airbrick covers);
- The availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc.; and
- The time taken to respond to a flood warning.

Ensuring safe occupancy and access to and from the development, such as:

- Occupant awareness of the likely frequency and duration of flood events, and the potential need to evacuate;
- Safe access route to and from the development;
- If necessary, the ability to maintain key services during an event;
- Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and
- Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.)

There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. Each London Borough is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff.

Flood warning areas and emergency rest centres for each of the London Boroughs are described in Sections 4.2.7, 5.2.7, 6.2.7 and 7.3.7 and shown in **Appendix A Figure 2.6, Figure 3.6, Figure 4.6 and Figure 5.6.**

The Environment Agency issues flood warnings to residents and businesses that have registered for the service in these specific areas when flooding is expected. It should be noted that whether each of the emergency rest centres are operational during a flood event is dependent upon the locations and extent of flooding across the Borough at that particular time. The Multi Agency Flood Plan prepared by each of the London Boroughs will provide more detail on the appropriate use of each rest centre.

[44] Environment Agency Tool 'Make a Flood Plan'. https://www.gov.uk/government/publications/personal-flood-plan

10 Guidance for the Application of Sustainable Drainage Systems

10.1 What are Sustainable Drainage Systems?

Suitable surface water management measures should be incorporated into new development designs in order to reduce and manage surface water flood risk to, and posed by the proposed development. This should be achieved by incorporating Sustainable Drainage Systems (SuDS).

Sustainable Drainage Systems (SuDS) are surface water drainage solutions designed to manage surface water runoff and mitigate the adverse effects of urban storm water runoff by reducing flood risk and controlling pollution[45]. SuDS techniques allow surface water runoff from development to be controlled in ways that imitate natural drainage by controlling the rate of discharge to a receiving watercourse. SuDS may also provide valuable habitat and amenity value when carefully planned for in development.

The SuDS Manual[46] identifies four processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge:

A. **Infiltration:** the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed baseflows of local watercourses, but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable.

   The use of traditional infiltration techniques that infiltrate to the ground is dependent on the underlying ground conditions. An assessment of the suitability of using infiltration SuDS techniques across the Boroughs has been undertaken as part of the SWMP for each London Borough using the detailed BGS Infiltration SuDS Map. However, it is also possible to use shallow infiltration techniques in combination with storage techniques on sites which have impermeable geology, and therefore these techniques should not be overlooked.

B. **Detention/Attenuation:** the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.

   Detention measures are not constrained by geology, though in areas of permeable geology, there will also be a degree of infiltration of runoff taking place.

C. **Conveyance:** the transfer of surface runoff from one place to another, e.g. through open channels, pipes and trenches.

D. **Water Harvesting:** the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

As part of any SuDS scheme, consideration should be given to the long-term maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. Table 10-1 has been reproduced from the SuDS Manual, CIRIA C753 and outlines typical SuDS techniques.

45 Defra, Environment Agency (March 2015) Cost Estimation for SuDS - Summary of Evidence
46 CIRIA C753 SuDS Manual. http://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx

Table 10-1 Typical SuDS Components (Y; primary process. * some opportunities, subject to design)

Technique	Description	Conveyanc	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water, and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specified retention time.		Y		
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains, but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing because, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.	*	*	*	Y

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each development site must offset its own increase in runoff and attenuation cannot be "traded" between developments.

Other measures may also be required in relation to water and sewerage infrastructure that might include pipes and below ground storage required as part of a wider strategic scheme, to deal with surface water flood risk. Options may include:

- Increasing capacity in drainage systems;
- Separation of foul and surface water sewers;
- Improved drainage maintenance regimes; and,
- Managing overland flows.

10.2 Management Train

The concept used in the development of drainage systems is the surface water 'management train'[47] whereby different techniques can be used in series to change the flow and quality characteristics of runoff in stages that attempt to mimic natural drainage. The hierarchy of techniques that should be considered in developing the management train are[49]:

1. **Prevention –** the use of good site design and site housekeeping measures to prevent runoff and pollution (e.g. sweeping to remove surface dust and detritus from car parks), and rain water reuse/harvesting. Prevention policies should generally be included within the site management plan.
2. **Source controls –** control of runoff at or very near its source (e.g. soakaways, other infiltration methods, green roods, pervious pavements).
3. **Site controls –** management of water in a local area or site (e.g. routing water from building roofs and car parks to a large soakaway, infiltration or detention basin.)
4. **Regional controls –** management of runoff from a site or several sites, typically in a balancing pond or wetland.

Policy 5.13 in the London Plan sets out the drainage hierarchy that developers should follow for managing surface water in London Boroughs. The London Plan drainage hierarchy is set out in Section 2.5.1 of this SFRA.

Generally the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable:

A. Into the ground (infiltration)
B. To a surface water body
C. To a surface water sewer, highway drain, or another drainage system
D. To a combined sewer

Where possible, stormwater should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas. The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at the source should always be considered before site or regional controls. However, where upstream control opportunities are restricted, a number of lower hierarchy options should be used in series. Water should only be conveyed elsewhere if it cannot be dealt with at the site.

The passage of water between stages of the management train should be considered through the use of natural conveyance systems (e.g. swales and filter trenches) wherever possible. Pipework and sub-surface proprietary produce may still be required, especially where space is limited. Pre-treatment (i.e. the removal of silt and sediment loads) and maintenance is vital to ensure the long-term effectiveness of SuDS. Overland flow routes will also be required to convey and control floodwaters safely and effectively during extreme flood events. Generally, the greater the number of techniques used in a series the better the performance is likely to be and the lower the risk of overall system failure.

SuDS can be applied in all development situations, although individual site constraints may limit the potential of some sites achieving full benefits for all functions. The variety of SuDS available allows planners and designers to make full potential of the local land and consider the needs of local people when implementing the drainage design. The wishes of all the relevant stakeholders needs to be balanced in additional to the risk associated with each design option.

10.3 SuDS Costs

10.3.1 Whole Life Costs

Identifying whole life costs associated with SuDS is a complex process, and involves consideration of the following:

- Procurement and design costs;
- Capital construction costs;
- Operation and maintenance costs; Monitoring costs; and Replacement or decommissioning costs.

If the incorporation of SuDS is considered early in the design, as part of the wider landscaping and site planning phase, there is greater potential to manage the costs of SuDS effectively.

[47] ttp://www.ciria.org.uk/suds/suds_management_train.htm

Information on typical capital costs and maintenance costs are provided below. For further detail, and information on the other associated costs noted above, reference can be made to industry guidance such as the Defra and Environment Agency publication 'Cost Estimation for SuDS- Summary of Evidence' (Defra Environment Agency, March 2015).

10.3.2 Capital Costs

Defra and the Environment Agency have prepared a document containing unit costs for particular SUDS components based on a number of industry references. These have been compiled in Table 10-2. It is noted that these costs are based on actual costs from a number of projects from within the UK and from a wider literature review. If used for cost estimating purposes these costs should be increased to allow for inflation to present day values.

It should be noted that these costs are provided as an indicative cost for each type of SuDS. Whilst they provide a range of costs for each type and a relative assessment between SuDS features, the costs associated with any specific site will depend on a number of factors as follows:

- Scale and size of development;
- Hydraulic design criteria (design event, volume of storage required and impermeable catchment area);
- Inlet/outlet infrastructure design (volume and velocity of anticipated flows and the capacity of drainage system beyond site boundary);
- Water quality design criteria;
- Soil types (permeability and depth of water table), porosity and load bearing capacity;
- Materials availability;
- Density of planting;
- Specific Utilities requirements;
- Proximity to receiving watercourse;
- Amenity / public education / safety requirements

Table 10-2 Indicative costs for SUDS options (Defra, Environment Agency 2015)

Option	Unit cost	Source
Green roofs	£90/m^2 - covered roof with sedum mat £80/m^2 - biodiverse roof (varied covering of plants, growing medium and aggregates) Variable costs for Sedum blanket , turf and growing medium roof options	Bamfield, 2005. Bamfield, 2005. Rawlinson, 2006
Simple rainwater harvesting (water butts)	£100 - £243 per property (includes installation and connection pipe)	Stovin & Swan 2007
Advanced rainwater harvesting	£2,100 - £2,400 per residential property £2,500 - £6,000 per residential property £2,600 - £3,700 per residential property £6,300 - £21,000 per commercial / industrial property £45 per m^2 for residential properties £9 per m^2 for non-residential properties	Woking BC EA, 2007 RainCycle, 2005 RainCycle, 2005 EA, 2007 EA, 2007
Greywater re-use	£1,900 - £3,500 per residential property £3,000 per property	Woking BC EA, 2007
Permeable paving	£30-£40 per m^2 of permeable surface £27 per m^2 of replacement surface £54 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007
Filter drain / perforated pipes	£100 - £140 per m^3 stored volume £61 per m £120 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007
Swales	£10-£15 per m^2 swale area £18-£20 per m length using an excavator £12.5 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007

Option	Unit cost	Source
Infiltration basin	£10-£15 per m^3 stored volume	CIRIA, 2007
Soakaways	>£100 per m^3 stored volume £454 -£552 per soakaway	CIRIA, 2007 Stovin & Swan 2007
Infiltration trench	£55-£65 per m^3 stored volume £74-£99 per m length £60 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007
Filter strip	£2-£4 per m^2 filter strip area	CIRIA, 2007
Constructed wetland	£25-£30 per m^3 treated volume	CIRIA, 2007
Retention (wet) pond	£15-£25 per m^3 treated volume £80,000 per 5000m^3 pond (£16 per m3)	CIRIA, 2007 SNIFFER, 2007
Detention basin	£15-£20 per m^3 detention volume £35-£55 per m^3 stored volume £18 per m^3	CIRIA, 2007 Stovin & Swan 2007 SNIFFER, 2007
Onsite attenuation and storage	£449-£518 per m^3 for reinforced concrete storage tank. No data available for oversized pipes	Stovin & Swan 2007

10.3.3 Operation and Maintenance Costs

As with any other flood risk management structure, SuDS require ongoing maintenance to ensure the system remains in good working order and the design life of the system is extended as long as possible. Operation and maintenance activities will include the following:

- Monitoring and post-construction inspection;
- Regular, planned maintenance (annual or more frequent); and,
- Intermittent, refurbishment, repair/remedial maintenance;

Additional costs may include the allocation of resources and materials as a result of maintenance activities.

The long-term maintenance costs associated with SuDS are relatively unknown as they are usually absorbed by operators responsible for maintaining the infrastructure as part of their wider asset base.

Whilst the construction of SuDS (e.g. storage ponds) and wetlands are relatively straightforward to calculate, however, maintenance costs are slightly more difficult to estimate due to the lack of information regarding whom is responsible for this ongoing maintenance. The key factors that will influence maintenance costs include:

- Type and frequency of maintenance required (e.g. sediment removal, inlet/outlet maintenance, landscaping, and litter removal).
- The costs of maintenance (materials, labour and equipment costs);
- The availability and source of materials and disposal costs; and,
- The responsibility for maintenance (e.g. LA, highways agency, residents, developer).

The table below outlines some generic SuDS costs based on review of literature and some UK case studies undertaken by HR Wallingford (2004).

Table 10-3 Indicative annual maintenance costs for key SuDS options[48]

Option	Annual Maintenance costs	
Green roofs	£2,500/yr for first 2 years for covered rood with sedum mat, £600/yr after. £1,250/yr for first 2 years for covered rood with biodiverse roof, £150/yr after.	Bamfield (2005) Bamfield (2005)
Simple rainwater harvesting (water butts)	Negligible	

[48] Defra, Environment Agency (March 2015) Cost Estimation for SuDS - Summary of Evidence.

Option	Annual Maintenance costs	
Advanced rainwater harvesting	£250 per year per property for external maintenance contract	RainCycle
Permeable paving	£0.5 - £1/m3 storage volume	HR Wallingford, 2004
Filter drain/perforated pipes	£0.2 - £0.1/m2 of filter surface area	HR Wallingford, 2004
Swales	£0.1/m2 of swale surface area £350/yr	HR Wallingford, 2004 Ellis, 2003
Infiltration basin	£0.1 - £0.3/m2 of detention basin area £0.25 - £1/m3 of detention volume	HR Wallingford, 2004
Soakaways	£0.1/m2 of treated area	HR Wallingford, 2004
Infiltration trench	£0.2 - £1/m2 of filter surface area	HR Wallingford, 2004
Filter strip	£0.1/m2 of filter surface area	HR Wallingford, 2004
Constructed wetland	£0.1/m2 of wetland surface area. Annual maintenance of £200-250/yr for first 5 years (declining to £80 - £100/yr after 3 year)	HR Wallingford, 2004 Ellis, 2003
Retention (wet) pond	£0.5 - £1.5/m2 of retention pond surface area £0.1 - £2/m3 of pond volume	HR Wallingford, 2004 HR Wallingford, 2004 Ellis, 2003
Detention basin	£0.1 - £0.3/m2 of detention basin area £0.25 - £1/m3 of detention volume £250-£1000 per basin	HR Wallingford, 2004 HR Wallingford, 2004 Ellis, 2003

10.4 What is the role of the London Boroughs?

As described in Section 2.4, separate to their capacity as the LPA, each of the London Boroughs are statutory consultees for surface water drainage as part of their role as LLFAs. From 6 April 2015, all major development[49] should include provision for SuDS and a Sustainable Drainage Strategy will need to be completed and signed by a competent drainage engineer to verify that the proposals conform to the Government's 'Sustainable Drainage Systems: Non-Statutory Technical Standards[50].

The following sections provide an overview of the Technical Standards and items which applicants should include when preparing a Sustainable Drainage Strategy for submission to the LLFA.

10.4.1 What are the Technical Standards?

A set of non-statutory Technical Standards have been published, to be used in conjunction with supporting guidance in the PPG, which set the requirements for the design, construction, maintenance and operation of sustainable drainage systems (SuDS). The Technical Standards that are of chief concern in relation to the consideration of flood risk to and from development relating to peak flow control and volume control are presented below:

Peak flow control

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

[49] Developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010).
[50] Sustainable drainage systems: non-statutory technical standards - https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

Volume control

S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Flood risk within the development

S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

All major[51] developments and other development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff.

Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible in accordance with the requirements of the Technical Standards and supporting guidance published by DCLG and Department for the Environment, Food and Rural Affairs (Defra)[52].

10.4.2 What should a Sustainable Drainage Strategy include?

There will be 3

- A plan of the existing site.
- A topographical level survey of the area to metres Above Ordnance Datum (MAOD).
- Demonstration of a clear understanding of how surface water flows across the site and surrounding area. This could use the topographic survey and the information presented on the 'Flood Map for Surface Water' on the Environment Agency website and with the Council's Surface Water Management Plan (SWMP).
- Plans and drawings of the proposed site layout identifying the footprint of the area being drained (including all buildings, access roads and car parks).
- Calculations of:
    - Changes in permeable and impermeable coverage across the site.
    - The existing and proposed controlled discharge rate for a 1 in 1 year event, 1 in 30 year and a 1 in 100 year event (with an allowance for climate change), which should be based on the estimated greenfield runoff rate.
    - Proposed storage volume (attenuation) including the water storage capacity of the proposed drainage features, with demonstration that they meet the requirements of the Technical Standards.
- Plans, drawings and specification of proposed SuDS measures. This should include detail of hard construction, soft landscaping and planting. A drainage design can incorporate a range of SuDS techniques.

[51] Major development – 10 or more dwellings and 1000 sqm floorspace

[52] Sustainable drainage systems: non-statutory technical standards - https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards; PPG Flood Risk and Coastal Change - http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/

- A design statement describing how the proposed measures manage surface water as close to its source as possible and follow the drainage hierarchy in the London Plan.
- Geological information including borehole logs, depth to water table and/or infiltration test results in accordance with BRE365.
- Details of overland flow routes for exceedance events.
- Details of any offsite works required, together with necessary consents (where relevant).
- A management plan for future maintenance and adoption of drainage system for the lifetime of the development.

Applicants are strongly encouraged to discuss their proposals with the LLFA at the pre-application stage. Requests can be made using the contact details set out overleaf:

LONDON BOROUGH OF CROYDON:

https://www.croydon.gov.uk/planningandregeneration/pre-application-services

Email: enquiries.llfa.suds@croydon.gov.uk

Development Management Team
Bernard Weatherill House
8 Mint Walk
Croydon CR0 1EA

General enquires: 020 8255 2864

LONDON BOROUGH OF MERTON:

http://www.merton.gov.uk/environment/planning/planningapplications/dcpreappadvice.htm

Environment and Regeneration Department
London Borough of Merton
Civic Centre
London Road
Morden
SM4 5DX

Telephone: 020 8274 4901

Email: trafficandhighways@merton.gov.uk

LONDON BOROUGH OF SUTTON:

https://www.sutton.gov.uk/info/200155/planning/1113/pre-application_planning_advice

24 Denmark Road
Carshalton
Surrey
SM5 2JG

General enquiries: 020 8770 5000

Enquiries: danielle.ford@sutton.gov.uk

Website: www.sutton.gov.uk

LONDON BOROUGH OF WANDSWORTH:

http://www.wandsworth.gov.uk/info/485/planning_permission/1321/pre-application_advice

Wandsworth Council
The Town Hall
Wandsworth High Street
London SW18 2PU

Reception email: enquiries@wandsworth.gov.uk

Switchboard telephone: 020 8871 6000

10.5 Drainage Catchments

As described in Section 3.3.4, Drainage Catchments have been delineated across the study area based on the natural catchment and watersheds. It is recommended that London Boroughs refer to these when developing policies for surface water management requirements to determine whether they wish to set additional standards for specific parts of their administrative area.

Sustainable Design and Construction SPG states that developers should maximise all opportunities to achieve greenfield runoff rates in their developments, or aim for as close to Greenfield runoff rates as reasonably possible from their developments. Greenfield runoff rates are defined as the runoff rates from a site, in its natural state, prior to any development (8 litres per second per hectare). This is particularly important for developments that contribute to a combined sewer system. If Greenfield runoff rates are not possible, developers should achieve 50% attenuation of a site's existing surface water runoff at peak times, as a minimum. As the whole drainage catchment contributes to surface water runoff, it is recommended that this policy is not only applied to areas 'at risk' of flooding, but also incorporates the entire drainage catchment in order to attenuate surface water upstream.

10.6 Use of infiltration SuDS

Improper use of infiltration SuDS can lead to contamination of superficial deposits and bedrock aquifers, leading to deterioration of groundwater quality, or increased flood risk. On the other hand, appropriate use of infiltration SuDS may improve groundwater quality status and decrease the flood risk.

The locations most appropriate for infiltration SuDS exist where there is a combination of high ground and permeable geology. However, when implementing this type of SuDS, it is vital that the impact on properties down gradient is considered. Increasing infiltration in an area will lead to increased groundwater levels, thus an increased susceptibility to groundwater flooding down the catchment.

At each development site groundwater levels should be assessed prior to the implementation of SuDS. This will help confirm their potential function (e.g. soakaways) even after long periods of rainfall. This is particularly important where superficial deposit dominate as their thickness is unpredictable. If they are thick and impermeable, shallow soakaways may not intercept the underlying permeable bedrock. If they are thin and permeable, but perched over impermeable bedrock, they may not receive the additional recharge from the infiltration SuDS.

Infiltration SuDS should not be implemented near to areas of historic landfill or any other areas of known contamination. This is to ensure that drainage does not re-mobilise latent contamination which would exacerbate the risk to groundwater quality.

If ground conditions are not suitable for infiltration SuDS techniques then surface waters can still be managed using surface infiltration techniques in combination with attenuation SuDS measures. These attenuate surface runoff to reduce flood risk both within the site and to the surrounding areas. Furthermore, areas upstream of critical flood areas can be used to install attenuation SuDS to slow the flood of water reaching the high risk area.

The rest of this section identifies where infiltration SuDS could be applied in each Borough based on the bedrock and superficial geology of each area. The information is supported by each Borough's SWMP.

10.6.1 London Borough of Croydon

Bedrock Geology

The bedrock geology of Croydon comprises of Upper Chalk in the south, which is overlain by Thanet Sand Formation (fine sand), Lambeth Group (clay and sand), Harwich Formation (sand and flint) and the London Clay Group in the north.

Superficial Geology

The superficial geology in the area consists of Head, Clay with Flints and River Terrace Deposits. Head deposits crop out as thin ribbons in the Wandle Valley and its tributaries. The deposits are dominated by clay originating from the London Clay Formation. The River Terrace Deposits form the largest part of the superficial geology and consist of three main units: Kempton Park Gravel Formation, Hackney Gravel Member, Lynch Hill Gravel Member and Sand and Gravels.

Suitability of Infiltration SuDS based on Geology

- Drain London Mapping suggests that there is low potential for elevated groundwater levels where the Lambeth Group, Harwich Formation and Thanet Sand Formation outcrop at the surface. However, this could be due to data limitations; therefore further investigation in this area would be beneficial.
- There have been a number of groundwater flood events in the Harwich Formation in the Spring Park, Addiscombe and Monks Orchard areas. Therefore infiltration SuDS should not be allocated here.
- Groundwater levels in the London Clay Formation, Lambeth Group and Thanet Sand Formation depends on their hydraulic connectivity with the underlying Chalk and the presence of any clay. Therefore to establish the suitability of infiltration SuDS in this location will require specific site investigations to confirm the depth of the groundwater and any seasonal fluctuations prior to any development.
- The Upper Chalk bedrock is water bearing and therefore has increased potential for elevated groundwater. This includes Addington to the east, Waddon and South Croydon in the west and Purley in the south. There has been extensive groundwater flooding in the south of the Borough in recent years, and therefore infiltration SuDS should not be considered in these locations.
- There is a history of groundwater flooding the in the northwest where superficial geology overlays the London Clay Formation, this therefore indicates that it would not be appropriate to implement infiltration SuDS, particularly around Broad Green. The depth of the groundwater level in these superficial deposits is likely to vary and therefore further investigations should take place to assess the suitability of infiltration SuDS here, particularly in the topographic lows near the surface water courses.

- Another factor for consideration is the location of historic landfill. Infiltration SuDS must not promote the re-mobilisation of latent contamination that would promote groundwater quality risks. In the north there are a few areas of historic landfill (namely South Norwood Country Park), which must be avoided for use of infiltration SuDS.
- Where the London Clay Formation is at the surface and there are no overlying superficial deposits the potential for elevated groundwater is negligible and therefore infiltration SuDS should not be installed here.
- Much of the south of Croydon consists of unconfined chalk and Basal Sands where groundwater can be elevated. There is a history of groundwater flooding in the southern part of the Borough and in these locations the use of SuDS is not advisable. Where the London Clay Formation is present infiltration SuDS are not suitable.
- The areas in-between (i.e. the superficial River Terrace Deposits) requires further investigation to assess the ability of the ground to store and transmit infiltration without processing flooding or drainage issues. Where the Clay and Flints dominate the suitability of infiltration SuDS will depend on the thickness of this layer – any soakaways will need to penetrate the underlying chalk.

10.6.2 London Borough of Merton

Bedrock Geology

The underlying bedrock of Merton is almost entirely London Clay, with a small area of Claygate Member and Bagshot Formation to the northwest.

Superficial Geology

The majority of the superficial deposits are various River Terrace Deposits (gravel, sandy and clayey in part), which differentiate on the basis of altitude but are geologically similar. These can be sub-divided into Taplow Gravel Formation and Hackney Gravel Member which are located in the Mitcham area; Kempton Park Grave in Merton and New Malden and Black Park Gravel is located on the higher ground at Wimbledon. Ribbons of Alluvium (mainly sand, silt and clay) are distributed along the River Wandle and Beverley Brook.

Suitability of Infiltration SuDS based on Geology

- In the northwest the Claygate Member, Bagshot Formation and overlying superficial deposits are thought to be water bearing. The EA groundwater flood incident data suggests that underground structures (e.g. basements) could be vulnerable to groundwater flooding. Therefore infiltration SuDS in this area are not a viable option.
- In the northwest where the Bagshot Formation overlies the Claygate Member site investigations will be key for any proposed developments, particularly those which contain basements/underground structures (e.g. soakaways). The usage of infiltration SuDS should be considered when these site examinations take place. In the southeast there are several historic landfill sites which must be avoided for infiltration SuDS due to the risk of latent contamination which could lead to groundwater quality issues.
- In the low elevation land where London Clay Formation is overlain by superficial deposits there is increased potential for elevated groundwater. It is implied that where groundwater table exist they are likely to be close to the surface, therefore basements and structures such as sheet pilling may exacerbate the problem if they intercept the water table. Infiltration SuDS could further exacerbate the problem here therefore should be exempt at this location. Superficial deposits often vary in composition; therefore site investigations will be key for proposed development sites in order to gain better understanding of the groundwater conditions. Alongside this it is possible to determine if infiltration SuDS will be suitable for this location.
- Where the impermeable London Clay Formation outcrop at the surface at low elevation there are no overlying superficial deposits therefore the potential for elevated groundwater is said to be negligible. However, there are areas where this bedrock has been removed and replaced by artificial material, meaning groundwater could become trapped. These areas could be potential sites for infiltration SuDS.
- Generally speaking the majority of Merton is potentially unsuitable for infiltration SuDS; mainly where impermeable London Clay Formation is at the surface. Where River Terrace Deposits overlay it is uncertain if infiltration SuDS are appropriate as it is unknown whether the River Terrace Deposits will store and transmit groundwater without causing flooding or draining issues. Merton Council has confirmed that past ground investigations have shown a shallow perched groundwater layer is common across the majority of the borough, which can result in groundwater ingress to basements if tanking is not appropriate or up to standard. Further ground investigation is required in areas where perched groundwater may occur.
- There are several historic landfill sites to the east of Merton in the Mitcham area, particularly beneath Mitcham Common. Infiltration SuDS should be avoided here as they could increase the risk of impaired groundwater quality.

10.6.3 London Borough of Sutton

Bedrock Geology

Sutton bedrock has a large north/south divide with London Clay Formation dominating in the north and Upper Chalk to the south. In the middle of the Borough there is a band of Lambeth Group and Thanet Sand Formation.

Superficial Geology

Overlaying this there is an area of superficial Hackney Gravel Member geology in the northeast. To the south, overlying the Upper Chalk, there are ribbons of superficial Head deposits.

Suitability of Infiltration SuDS based on Geology

- Both the Lambeth Group and Thanet Sand Formation are aquifers and therefore water bearing. It is suggested that there is a fairly low potential for elevated groundwater, however, this depends on the degree of hydraulic continuity with the underlying chalk aquifer. Site specific investigations should take place prior to development to confirm the depth of groundwater and monitor seasonal fluctuations. This will also indicate the feasibility of utilising infiltration SuDS.
- Upper chalk is a principal aquifer and therefore water bearing therefore is potentially suitable for infiltration SuDS. There is increased potential for elevated groundwater towards the northern extent of the chalk outcrop, particularly around Carshalton and Wallington. Therefore infiltration SuDS in this area of Sutton may be more suitable.
- In the northwest quarter of Sutton, London Clay Formation dominates. Due to its impermeability this area is potentially unsuited for infiltration SuDS. However, because it is an aquiclude and thus does not permit the flow of groundwater, groundwater will not be a key source of flooding in these areas.
- Many of the superficial deposits in Sutton are water bearing and therefore have an increased potential for elevated groundwater. The key areas of interest are where the River Terrace Deposits are in some hydraulic continuity with the River Wandle and its tributaries. However, there is a lack of continuous groundwater level data confirming the depth of water within superficial deposits, or the degree to which level fluctuate with river stage. Therefore it is uncertain the ability of River Terrace Deposits to store and transmit groundwater without causing flooding or drainage issues is uncertain. Site investigations should proceed for all proposed development sites, particularly those including basements and any underground structures (e.g. soakaways).
- With regard to historic landfill sites, there are three areas to consider: Rosehill, Therapia Lane and Woodmansterne Road. These areas should be careful considered with regard to infiltration SuDS as there is increased risk of groundwater contamination.

10.6.4 London Borough of Wandsworth

Bedrock Geology

In Wandsworth the London Clay Formation dominates the surface bedrock geology across the Borough. The only exception to this is a small area that is overlain by Claygate Member near Wimbledon Common (south west) and a patch of Lambeth Group outcrops in the Upper Tooting area (south east). London Clay Formation is an aquiclude with low to very low permeability, thus prohibits groundwater flow.

Superficial Geology

The majority of Wandsworth is overlain with superficial deposits, consisting of River Terrace Deposits, Head, Langley Silt Member and Alluvium. The River Terrace Deposits consist of various different units based on altitude but are largely geographically similar (gravel, sandy and clayey in part). Strands of Alluvium correspond with the River Wandle, Beverley Brook and River Thames and are mainly sand, silt and clay in nature.

Suitability of Infiltration SuDS based on Geology

- Due to the extensive London Clay Formation in Wandsworth, no areas are deemed suitable for infiltration SuDS.
- However, areas overlain by superficial deposits are likely to be variable in composition and depth across Wandsworth, therefore individual site investigations should be encouraged to understand the local groundwater conditions, thus suitability of infiltration SuDS.
- London Clay Formation is an aquiclude, meaning it does not permit groundwater flow. In areas where this bedrock outcrops at the surface elevated groundwater is negligible. However, in some locations this bedrock has been removed and replaced with artificial ground material. This may increase the potential for elevated groundwater as it may become trapped in these deposits. Infiltration SuDS should be avoided here.

- There are two historic landfill sites to the north and north east of Wandsworth. Infiltration SuDS must not be installed here as this could introduce groundwater quality issues.

11 Guidance for preparing site-specific FRAs

11.1 What is a Flood Risk Assessment?

A site-specific FRA is a report suitable for submission with a planning application which provides an assessment of flood risk to and from a proposed development, and demonstrates how the proposed development will be made safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with paragraph 100 of the NPPF and PPG. An FRA must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow the LPAs (London Boroughs of Croydon, Merton, Sutton and Wandsworth) to be satisfied that the requirements have been met.

11.2 When is a Flood Risk Assessment required?

The NPPF states that a site-specific FRA is required in the following circumstances:

- **Proposals for new development (including minor development[53] and change of use) in Flood Zones 2 and 3.**
- **Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency)[54].**
- **Proposals of 1 hectare or greater in Flood Zone 1.**
- **Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.**

11.3 How detailed should a FRA be?

The PPG states that site-specific FRAs should be proportionate to the degree of flood risk, the scale and nature of the development, its vulnerability classification (Table 8-2) and the status of the site in relation to the Sequential and Exception Tests. Site-specific FRAs should also make optimum use of readily available information, for example the mapping presented within this SFRA and available on the Environment Agency website, although in some cases additional modelling or detailed calculations will need to be undertaken. For example, where the development is an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people present in an area at risk of flooding, the LPA would generally need a less detailed assessment to be able to reach an informed decision on the planning application. For a new development comprising a greater number of houses in a similar location, or one where the flood risk is greater the LPA may require a more detailed assessment, for example, the preparation of site-specific hydraulic modelling to determine the flood risk to and from the site pre and post-development, and the effectiveness of any management and mitigation measures incorporated within the design.

As a result, the scope of each site-specific FRA will vary considerably. Table 11-1 presents the different levels of site-specific FRA as defined in the CIRIA publication C624[55] and identifies typical sources of information that can be used. Sufficient information must be included to enable the Council and where appropriate, consultees, to determine that the proposal will be safe for its lifetime, not increase flood risk elsewhere and where possible, reduce flood risk overall. Failure to provide sufficient information will result in applications being refused.

[53] According to the PPG, minor development means:
minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m2.
alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
householder development: for example; sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

[54] Consultation has confirmed that there are no areas with critical drainage problems identified by the Environment Agency.

[55] CIRIA, 2004, Development and flood risk - guidance for the construction industry C624.

Table 11-1 Levels of Site-Specific Flood Risk Assessment

Level of Site-Specific Flood Risk Assessment	Description
Level 1 Screening study	Identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information. The screening study will ascertain whether a FRA Level 2 or 3 is required. Typical sources of information include: • Strategic Flood Risk Assessment (SFRA) • Flood Map for Planning (Rivers and Sea) • Surface Water Management Plan (SWMP) • Environment Agency Standing Advice • NPPF Tables 1, 2 and 3
Level 2 Scoping study	To be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk due to increased run-off. This study should confirm the sources of flooding which may affect the site. The study should include: • An appraisal of the availability and adequacy of existing information; • A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; and • An appraisal of the scope of possible measures to reduce flood risk to acceptable levels. • The scoping study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development. Typical sources of information include those listed above, plus: • Local policy statements or guidance. • Thames Catchment Flood Management Plan (CFMP) • Thames Estuary 2100 Plan. • London Borough Croydon, Merton, Sutton and Wandsworth council's PFRA and LFRMS. • Data request from the EA to obtain result of existing hydraulic modelling studies relevant to the site and outputs such as maximum flood level, depth and velocity. • Consultation with LLFA, Environment Agency, Thames Water and other flood risk consultees to gain information and to identify in broad terms, what issues related to flood risk need to be considered including other sources of flooding. • Historic maps. • Interviews with local people and community groups. • Walkover survey to assess potential sources of flooding, likely routes for floodwaters, the key features on the site including flood defences, their condition. • Site survey to determine general ground levels across the site, levels of any formal or informal flood defences.
Level 3 Detailed study	To be undertaken if a Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include: • Quantitative appraisal of the potential flood risk to the development; • Quantitative appraisal of the potential impact of the development site on flood risk elsewhere; and • Quantitative demonstration of the effectiveness of any proposed mitigations measures. Typical sources of information include those listed above, plus: • Detailed topographical survey. • Detailed hydrographic survey. • Site-specific hydrological and hydraulic modelling studies which should include the effects of the proposed development. • Monitoring to assist with model calibration/verification. Continued consultation with the LPA, Environment Agency and other flood risk consultees.

11.3.1 Environment Agency Data Requests

The Environment Agency offers a series of 'products' for obtaining flood risk information suitable for informing the preparation of site-specific FRAs as described on their website https://www.gov.uk/planning-applications-assessing-flood-risk.

- Products 1 – 4 relate to mapped deliverables including flood level and flood depth information and the presence of flood defences local to the proposed development site;
- Product 5 contains the reports for hydraulic modelling of the Main Rivers, or Breach Modelling;
- Product 6 contains the model output data so the applicant can interrogate the data to inform the FRA.
- Product 7 comprises the hydraulic model itself.
- Product 8 contains flood defence breach hazard mapping.

Products 1 – 6 and 8 can be used to inform a Level 2 FRA. In some cases, it may be appropriate to obtain Product 7 and to use as the basis for developing a site-specific model for a proposed development as part of a Level 3 FRA. This can be requested via either their National Customer Contact Centre via enquiries@environment-agency.gov.uk or the Customer and Engagement Team via KSLEnquiries@environment-agency,gov.uk.

11.3.2 Modelling of Ordinary Watercourses

It should be noted that the scope of modelling studies undertaken by the Environment Agency typically cover flooding associated with Main Rivers, and therefore Ordinary Watercourses that form tributaries to the Main Rivers may not always be included in the model. Where a proposed development site is in close proximity to an Ordinary Watercourse and either no modelling exists, or the available modelling is considered to provide very conservative estimates of flood extents (due to the use of national generalised JFLOW modelling), applicants may need to prepare a simple hydraulic model to enable more accurate assessment of the probability of flooding associated with the watercourse and to inform the site-specific FRA. This should be carried out in line with industry standards and in agreement with the Environment Agency and the LLFAs.

11.4 What needs to be addressed in a Flood Risk Assessment?

The PPG states that the objectives of a site-specific flood risk assessment are to establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- the evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- whether the development will be safe and pass the Exception Test, if applicable.

11.5 Flood Risk Assessment Checklist

Table 11-2 provides a checklist for site-specific FRAs including the likely information that will need to be provided along with references to sources of relevant information. As described in Section 11.3, the exact level of detail required under each heading will vary according to the scale of development and the nature of the flood risk. It is expected that this Checklist is completed for all planning applications.

Table 11-2 Site-Specific Flood Risk Assessment Checklist (building on guidance in PPG)

What to Include in the FRA		Source(s) of Information
1.Site Description		
Site address	-	-
Site description	-	-
Location plan	Including geographical features, street names, catchment areas, watercourses and other bodies of water	SFRA Appendix A Figure 1.0
Site plan	Plan of site showing development proposals and any structures which may influence local hydraulics e.g. bridges, pipes/ducts crossing watercourses, culverts, screens, embankments, walls, outfalls and condition of channel	OS Mapping Site Survey
Topography	Include general description of the topography local to the site. Where necessary, site survey may be required to confirm site levels (in relation to Ordnance datum). Plans showing existing and proposed levels.	Site Survey Ground Investigation Report London Borough of Croydon SWMP: https://www.croydon.gov.uk/planningandregeneration/framework/lpevidence/climatechange/flooding London Borough of Merton SWMP: http://www.merton.gov.uk/environment/flooding/flooding-how.htm London Borough of Sutton SWMP: https://www.sutton.gov.uk/info/200487/flood_risk_management/1279/flood_risk_policy/2 London Borough of Wandsworth SWMP: http://www.wandsworth.gov.uk/downloads/download/1149/surface_water_management_plan
Geology	General description of geology local to the site.	
Watercourses	Identify Main Rivers and Ordinary Watercourses local to the site.	
Status	Is the development in accordance with the LPA's Local Plan?	Seek advice from the relevant LPA if necessary: London Borough of Croydon: https://www.croydon.gov.uk/planningandregeneration/framework/localplan London Borough of Merton: http://www.merton.gov.uk/environment/planning/planningpolicy/localplan.htm London Borough of Sutton: https://www.sutton.gov.uk/info/200464/planning_policy/1344/local_plan London Borough of Wandsworth: http://www.wandsworth.gov.uk/info/1004/planning_policy/1366/local_plan
2. Assessing Flood Risk		
The level of assessment will depend on the degree of flood risk and the scale, nature and location of the proposed development. Refer to Table 11-1 regarding the levels of assessment. Not all of the prompts listed below will be relevant for every application.		

Tidal Flooding (Wandsworth)	Provide a plan of the site and Flood Zones. Identify any historic flooding that has affected the site, including dates and depths where possible. How is the site likely to be affected by climate change? Determine hazard risk and flood levels on the site from the updated Environment Agency Thames breach modelling. If necessary, undertake new hydraulic breach modelling to determine the flood level, depth, velocity, hazard, rate of onset of flooding on the site.	SFRA Appendix A Figures 5.7, 5.8 and 5.9. Updated Environment Agency Thames breach modelling outputs (Environment Agency Product 8). New hydraulic model.
Flooding from Rivers	Provide a plan of the site and Flood Zones. Identify any historic flooding that has affected the site, including dates and depths where possible. How is the site likely to be affected by climate change? Determine flood levels on the site for the 1% annual probability (1 in 100 chance each year) flood event including an allowance for climate change. Determine flood hazard on the site (in terms of flood depth and velocity). Undertake new hydraulic modelling to determine the flood level, depth, velocity, hazard, rate of onset of flooding on the site.	SFRA Appendix A Figures 2.1, 3.1, 4.1 and 5.1. Flood Map for Planning (Rivers and Sea) (Environment Agency website). Environment Agency Products 1-7. New hydraulic model.
Flooding from Surface water	Identify any historic flooding that has affected the site. Review the local topography and conduce a site walkover to determine low points at risk of surface water flooding. Review the Risk of Flooding from Surface Water mapping. Where necessary, undertake modelling to assess surface water flood risk.	SFRA Appendix A Figures 2.2, 3.2, 4.2 and 5.2. Site survey and walkover. Risk of Flooding from Surface Water mapping (Environment Agency website). New modelling study.
Flooding from Groundwater	Desk based assessment based on high level BGS mapping in the SFRA. Ground survey investigations. Identify any historic flooding that has affected the site.	SFRA Appendix A Figures 2.4, 3.4, 4.4 and 5.4. Ground Investigation Report
Flooding from Sewers	Identify any historic flooding that has affected the site.	SFRA Appendix A Figures 2.5, 3.5, 4.5 and 5.5. Refer to SFRA Section 4.5, 5.5, 6.4 and 7.6,
Reservoirs, canals and other artificial sources	Identify any historic flooding that has affected the site. Review the Risk of Flooding from Reservoirs mapping.	Risk of Flooding from Reservoirs mapping (Environment Agency website). Refer to SFRA Section 4.6, 5.6, 6.6 and 7.7.
3. Proposed Development		
Current use	Identify the current use of the site.	-
Proposed use	Will the proposals increase the number of occupants / site users on the site such that it may affect the degree of flood risk to these people?	-
Vulnerability Classification	Determine the vulnerability classification of the development. Is the vulnerability classification appropriate within the Flood Zone?	SFRA Table 8-2 SFRA Table 8-3

4. Avoiding Flood Risk		
Sequential Test	Determine whether the Sequential Test is required. Consult the LPA (Croydon, Merton, Sutton or Wandsworth Council) to determine if the site has been included in the Sequential Test. If required, present the relevant information to the LPA to enable their determination of the Sequential Test for the site on an individual basis.	SFRA Section 8.3
Exception Test	Determine whether the Exception Test is necessary. Where the Exception Test is necessary, present details of: Part 1) how the proposed development contributes to the achievement of wider sustainability objectives as set out in each of the London Borough's Sustainability Appraisal Reports. (Details of how part 2) can be satisfied are addressed in the following part 5 'Managing and Mitigating Flood Risk'.)	SFRA Table 8-3 Refer to SFRA Appendix B, Tables B-1, B-2, B-3 and B-4.

5. Managing and Mitigating Flood Risk		
Section 9 of the SFRA presents measures to manage and mitigate flood risk and when they should be implemented. Where appropriate, the following should be demonstrated within the FRA to address the following questions: How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime? How will you ensure that the proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere? Are there any opportunities offered by the development to reduce flood risk elsewhere? What flood-related risks will remain after you have implemented the measures to protect the site from flooding (i.e. residual risk) and how and by whom will these be managed over the lifetime of the development (e.g. flood warning and evacuation procedures)?		
Development Layout and Sequential Approach	Plan showing how sensitive land uses have been placed in areas within the site that are at least risk of flooding.	SFRA Section 9.2
Finished Floor Levels	Plans showing finished floor levels in the proposed development in relation to Ordnance Datum taking account of indicated flood depths.	SFRA Section 9.3
Flood Resistance	Details of flood resistance measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 9.4
Flood Resilience	Details of flood resilience measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 9.5
Safe Access / Egress	Provide a figure showing proposed safe route of escape away from the site and/or details of safe refuge. Include details of signage that will be included on site. Where necessary this will involve mapping of flood hazard associated with river flooding. This may be available from Environment Agency modelling, or may need to be prepared as part of hydraulic modelling specific for the proposed development site.	SFRA Section 9.7
Floodplain Compensation Storage	Provide calculations or results of a hydraulic modelling study to demonstrate that the proposed development provides compensatory flood storage and either will not increase flood risk to neighbouring areas or will result in an overall improvement. This should be located and designed to achieve level for level and volume for volume compensation, should be provided on land that is in hydrological continuity with the site within the applicant's ownership and subject to appropriate maintenance regimes for its lifetime. Include cross sectional drawings clearly showing existing and proposed site levels.	SFRA Section 9.9
Flow Routing	Provide evidence that proposed development will not impact flood flows to the extent that the risk to surrounding areas is increased. Where necessary this may require modelling.	SFRA Section 9.12

Riverside Development Buffer Zone	Provide plans showing how a buffer zone of relevant width will be retained adjacent to any Main River or Ordinary Watercourse in accordance with requirements of the Environment Agency or the London Borough Councils.	SFRA Section 9.13
Surface Water Management	Details of the following within FRA for all major development proposals in Flood Zones 1, 2 or 3: • Calculations (and plans) showing areas of the site that are permeable and impermeable pre and post-development. • Calculations of pre and post-development runoff rates and volumes including consideration of climate change over the lifetime of the development. • Details of the methods that will be used to manage surface water (e.g. permeable paving, swales, wetlands, rainwater harvesting). • Reference the supporting Sustainable Drainage Strategy for the site. • Information on proposed management arrangements	SFRA Section 10 Refer to Merton Council website for details on what should be included in a Sustainable Drainage Strategy: http://www.merton.gov.uk/environment/flooding/surfacewaterdrainage.htm
Flood Warning and Evacuation Plan	Where appropriate reference the Flood Warning and Evacuation Plan or Personal Flood Plan that has been prepared for the proposed development (or will be prepared by site owners).	SFRA Section 9.14

11.6 Pre-application Advice

At all stages, the LPA (Croydon, Merton, Sutton or Wandsworth Council) and where necessary the Environment Agency and/or the Statutory Water Undertaker may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.

The Environment Agency and London Borough Councils offer pre-application advice services which should be used to discuss particular requirements for specific applications.

- London Borough of Croydon
  https://www.croydon.gov.uk/planningandregeneration/pre-application-services
- London Borough of Merton
  http://www.merton.gov.uk/environment/planning/planningapplications/dcpreappadvice.htm
- London Borough of Sutton
  https://www.sutton.gov.uk/info/200155/planning/1113/pre-application_planning_advice
- London Borough of Wandsworth
  http://www.wandsworth.gov.uk/info/485/planning_permission/1321/pre-application_advice
- Environment Agency
  http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/research/planning/33580.aspx

12 Flood Risk Policy and Development Management Considerations

12.1 Introduction

As set out in Section 2, at the point of preparation of the SFRA, each of the London Boroughs are at slightly different stages in the development of their Local Plans and associated policies and site allocations.

- The Croydon Local Plan: Strategic Policies were adopted in April 2013. A partial review of these policies is currently underway. The Detailed Policies and Proposals are currently being produced and will contain development management planning policies and site specific allocations
- London Borough of Merton's Sites and Policies Plan was adopted in July 2014 along with the Policies Map which shows sites allocated for specific development.
- London Borough of Sutton is undertaking a review of the Local Plan, including revisions to the Council's strategic policies and proposals for future development, as well as revisions to site allocations and development management policies.
- London Borough of Wandsworth has undertaken a review of its Local Plan (Local Plan 2nd Proposed Submission Version) which was submitted to the Secretary of State for Examination on 12 March 2015. This includes a Development Management Policies Document and Site Specific Allocations Document.

The purpose of this Section is to present recommendations consistent with the NPPF and PPG for consideration by the London Boroughs when developing flood risk management policies. Some of the recommendations are common to all four boroughs, and some are specific to particular boroughs. It should be noted that it is ultimately the responsibility of the LPAs to formally formulate these policies and implement them.

12.2 Policy Considerations

It is recommended that the following flood risk objectives are taken into account during the policy making process. Guidance on how these objectives can be met throughout the development control process for individual development sites is included within Section 9.

12.2.1 Seeking Flood Risk Reduction through Spatial Planning and Site Design

- Use the Sequential Test to locate new development in areas of lowest risk, giving highest priority to areas within Flood Zone 1.
- Use the Sequential Test within development sites to inform site layout by locating the most vulnerable elements of a development in the lowest risk areas. For example, the use of low-lying ground in waterside areas for recreation, amenity and environmental purposes can provide an effective means of flood risk management as well as providing connected green spaces with consequent social and environmental benefits.
- Avoid development immediately downstream of flood storage reservoirs which will be at high hazard areas in the event of failure.
- Seek opportunities for new development to achieve reductions to wider flood risk issues where possible, e.g. larger developments may be able to make provisions for flow balancing within new attenuation SuDS features.
- Identify long-term opportunities to remove development from the floodplain through land swapping.
- Build resilience into a site's design (e.g. flood resistant or resilient design, raised floor levels).
- Ensure development is 'safe'. For residential developments to be classed as 'safe', dry pedestrian egress out of the floodplain and emergency vehicular access should be possible. Dry pedestrian access/egress should be possible for the 1 in 100 year return period event including an allowance for climate change associated with fluvial flooding. In the defended tidal floodplain in Wandsworth, safe access should also be provided during the MLWL including an allowance for climate change over the lifetime of the proposed development.

12.2.2 Reducing Surface Water Runoff from New Developments

- All sites require the following:
    - Use of SuDS (where possible use of strategic SuDS should be made).
    - Discharge rates should be restricted to Greenfield runoff rates.
    - For brownfield sites, runoff rates should not be more than three times the calculated greenfield rate, in line with the Sustainable Construction and Design SPG (Section 2.5.2). As a minimum requirement 50% of the existing rates should be achieved, in accordance with the London Plan.
    - 1 in 100 year attenuation of surface water, taking including an allowance for climate change.
- Space should be specifically set aside for SuDS and used to inform the overall layout of development sites.
- Surface water drainage proposals should follow the London Plan drainage hierarchy (Section 2.5.1) and have a clear plan for the long term maintenance and adoption of the systems, prior to approval of any planning permission in line with national planning policy.
- Large potential development areas with a number of new allocation sites should look to develop a strategy for providing a joint SuDS scheme. This should be on an integrated and strategic scale and where necessary would require the collaboration of all developers involved in implementing a specific expansion area or site.

12.2.3 The Drainage Catchment areas should be considered for development sites that are not directly at risk of surface water flooding, to identify flow paths to areas downstream that are at risk from surface water flooding and could be impacted by the development. Mitigation measures, such as attenuation measures, should be used in the upper catchment areas to prevent increased risk to the downstream sites. Enhancing and Restoring the River Corridor

- An assessment of the condition of existing assets (e.g. bridges, culverts, river walls) should be made. Refurbishment and/or renewal of the asset should ensure that the design life is commensurate with the design life of the development. Developer contributions should be sought for this purpose.
- Those proposing development should look for opportunities to undertake river restoration and enhancement as part of a development to make space for water. Enhancement opportunities should be sought when renewing assets (e.g. de-culverting such as that undertaken in Wandle Park in London Borough of Croydon, the use of bio-engineered river walls, raising bridge soffits to take into account climate change).
- Avoid further culverting and building over culverts. Where practical, all new developments with culverts running through their site should seek to de-culvert rivers for flood risk management and conservation benefit. Any culverting or works affecting the flow of a watercourse requires the prior written consent of either the Environment Agency (for main rivers), or London Borough (for ordinary watercourses) under the terms of the Land Drainage/Water Resources Act 1991 and Flood and Water Management Act 2010. These regulatory bodies seek to avoid culverting, and their consent for such works will not normally be granted except as a means of access.
- Set development back from rivers, seeking an 8 metre wide undeveloped buffer strip for development by all watercourses including those where the Flood Zone does not exist. Under the terms of the Water Resources Act 1991 and the Land Drainage Byelaws, the prior written consent of the Environment Agency or London Borough is required for any proposed works or structures in, under, over or within 8m of a main river, 16m of the Thames Tidal defence (Wandsworth) or within 8m of ordinary watercourse asset or structure. This is to allow easy maintenance of the water course, and includes consent for fencing, planting and temporary structures.

12.2.4 Protecting and Promoting Areas for Future Flood Alleviation Schemes

- Protect Greenfield functional floodplain from future development (our greatest flood risk management asset) and reinstate areas of functional floodplain which have been developed (e.g. reduce building footprints or relocate to lower flood risk zones).
- London Borough of Sutton and London Borough of Merton should develop appropriate flood risk management policies for the areas within Flood Zone 3b Functional Floodplain that are currently developed, focusing on risk reduction measures, such as:
    - Reducing the land use vulnerability wherever possible;
    - Not permitting proposals for the change of use or conversion to a use with a higher vulnerability classification;
    - Seeking opportunities to ensure there is no increase or achieve a reduction in the number of people at risk (e.g. avoiding conversions and rebuilds of properties that result in an increase in the number of residential dwellings);

- Maintaining or reducing built footprint;
- Raising finished floor levels;
- Increasing floodplain storage capacity and creating space for flooding to occur by restoring functional floodplain;
- Reducing impedance to floodwater flow and restoring flood flow paths;
- Incorporating flood resilient and/or resistance measures;
- Ensuring development remains safe for users in time of flood (this may refer to the timely evacuation of properties prior to the onset of flooding in accordance with an individual Flood Warning and Evacuation Plan for the site).

- Identify sites where developer contributions could be used to fund future flood risk management schemes or can reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

12.2.5 Promoting the Use of Green Infrastructure

- Opportunities should be sought to combine surface water flood management options with green infrastructure corridors and Blue Ribbon Network of rivers and waterways, in line with the London Plan's approach to the provision, enhancement and management of green infrastructure (Policy 2.18). The All London Green Grid (ALGG)[56] SPG should be referenced when promoting the design and delivery of green infrastructure across London.

12.2.6 Improving Flood Awareness and Emergency Planning

- Seek to improve the emergency planning process using the outputs from the SFRA.
- Encourage all those within existing Flood Zone 3a and 3b (residential and commercial occupiers) to sign up to Flood Warning Service operated by the Environment Agency.
- Ensure robust emergency (evacuation) plans are implemented for new developments.

12.3 Development Management Considerations

12.3.1 Flood Zone 3b Functional Floodplain

The Functional Floodplain has been defined by each LPA in this SFRA. These areas should be safeguarded from development, with exemptions where development could reduce flood risk overall or improve floodplain storage.

Within this Level 1 SFRA each of the London Boroughs has defined Flood Zone 3b Functional Floodplain for their respective administrative areas using the 5% AEP defended flood outline as a starting point for the definition (as described in Section 3.2.4).

London Boroughs of Croydon, Merton, Sutton and Wandsworth:

Only Water Compatible developments are permitted in Flood Zone 3b, and Essential Infrastructure developments require the Exception Test (see Table 8-3). Where Water Compatible or Essential Infrastructure development cannot be located elsewhere, it must:

- Remain operational and safe for users in times of flood;
- Result in no net loss of flood storage;
- Not impede water flows; and
- Not increase flood risk elsewhere.

Proposals for the change of use or conversion to a use with a higher vulnerability classification should not be permitted. Basements, basements extensions, conversions of basements to a high vulnerability classification or self-contained units should not be permitted.

Where minor development is proposed, schemes should not affect floodplain storage or flow routes through the incorporation of the following mitigation measures in line with CIRIA guidance on SuDS:

[56] Mayor of London (2012) Green Infrastructure and Open environments: The All London Green Grid Supplementary Planning guidance.

- Raised finished floor levels;
- Voids and where possible;
- Direct or indirect floodplain compensation;
- Flood resilience measures;
- The removal of other non-floodable structures;
- Replacement of impermeable surfaces with permeable;
- Improved surface water drainage through the implementation of SuDS features such as water butts/rainwater harvesting;
- Living roofs;
- Infiltration trenches/soakaways; and
- Below ground attenuation tanks.

London Boroughs of Sutton and Merton:

Within the outline of the 5% annual probability (1 in 20 year) defended flood extent there are areas of existing development which are prevented from flooding by the presence of existing infrastructure or solid buildings. In these developed areas, existing built footprints, where it can be demonstrated that they exclude floodwater, should not be defined as 'Functional Floodplain' and the planning requirements associated with Flood Zone 3b do not apply. The undeveloped land surrounding these buildings are important flow paths and flood storage areas and properties within these areas will be subject to frequent flooding; therefore care must be given to the future sustainability of any development.

The consideration of whether a site is 'developed' or 'undeveloped' should be considered on a case-by-case basis as part of the planning application process, having regard to the presence of existing buildings on the site and the existing routing of floodwater through the site during times of flood.

Where redevelopment is proposed in developed areas, schemes should not increase the vulnerability classification of the site. All schemes must result in a net reduction in flood risk and ensure that floodplain storage and flow routes are not affected. This can be achieved through a combination of on and off-site measures including:

- Reducing the land use vulnerability;
- Seeking opportunities to ensure there is no increase or achieve a reduction in the number of people at risk (e.g. avoiding conversions and rebuilds of properties that result in an increase in the number of residential dwellings);
- Maintaining or reducing the built footprint
- Raising finished floor levels;
- Reducing surface water runoff rates and volumes from the site;
- Increasing floodplain storage capacity and creating space for flooding to occur by restoring functional floodplain;
- Reducing impedance to floodwater flow and restoring flood flow paths;
- Incorporating flood resilient and/or resistance measures;
- Ensuring development remains safe for users in time of flood (this may refer to the timely evacuation of properties prior to the onset of flooding in accordance with an individual Flood Warning and Evacuation Plan for the site).

12.3.2 Flood Zone 3a High Probability

London Boroughs of Croydon, Merton, Sutton and Wandsworth:

Flood Zone 3a High Probability comprises land having a 1% (1 in 100 year) annual probability or greater. Water Compatible and Less Vulnerable developments are permitted in Flood Zone 3a; Essential Infrastructure and More Vulnerable developments require the Exception Test and Highly Vulnerable development is not permitted in this flood zone (see Table 8-3). Where development is proposed opportunities should be sought to:

- Relocate existing development to land in zones with a lower probability of flooding;

- Reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques;
- Ensure it remains safe for users in times of flood; and
- Create space for flooding to occur by restoring natural floodplain and flood flow paths and by identifying, allocating and safeguarding open space for flood storage.

12.3.3 Flood Zone 2 Medium Probability

Flood Zone 2 Medium Probability comprises land having between a 1% (1 in 100 year) and 0.1% (1 in 1000 year) annual probability of flooding from fluvial watercourses. Water Compatible, Essential Infrastructure, Less Vulnerable and More Vulnerable developments are permitted in the Flood Zone 2, and Highly Vulnerable development requires the Exception Test (see Table 8-3). Where development is proposed in areas of Flood Zone 2, the planning policy approach is similar to Flood Zone 3a. Opportunities should be sought to:

- Relocate existing development to land in zones with a lower probability of flooding;
- Reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques;
- Ensure it remains safe for users in times of flood; and
- Create space for flooding to occur by restoring natural floodplain and flood flow paths and by identifying, allocating and safeguarding open space for flood storage.

12.3.4 Flood Zone 1 Low Probability

Flood Zone 1 Low Probability comprises land having a less than 0.1% (1 in 1000 year) annual probability of flooding from fluvial watercourses. All development vulnerability classifications are permitted in Flood Zone 1 (see Table 8-3). Where development over 1ha is proposed or there is evidence of flooding from another localised source in areas of Flood Zone 1, opportunities should be sought to:

- Ensure that the management of surface water runoff from the site is considered early in the site planning and design process;
- Ensure that proposals achieve an overall reduction in the level of flood risk to the surrounding area, through the appropriate application of sustainable drainage techniques.

12.3.5 Cumulative Impact of Minor and Permitted Development

The PPG advises that minor developments (as defined in Section 8.3) are unlikely to result in significant flood risk issues unless:

- they would have an adverse effect on a watercourse, floodplain or its flood defences;
- they would impede access to flood defence and management facilities; or
- where the cumulative impact of such developments would have a significant impact on local flood storage capacity or flood flows.

In parts of the study area there is potential for both minor development as well as permitted development to be considered to be having a cumulative impact on flood risk in the local area as a result of impacts on local flood storage capacity and flood flows. Given the small scale of the development in the context of the wider fluvial catchments it is not possible to undertake modelling to confirm the impact of such development.

There is opportunity for LPAs to consider making an Article 4 direction[57] to remove national permitted development rights for developed areas of land within Flood Zone 3b where cumulative impact is considered to be a problem. The removal of permitted development rights will ensure that a planning application and site-specific FRA will be required for any development in these areas.

FRAs for all minor development within Flood Zone 3 should demonstrate that the proposal is safe and will not increase flood risk elsewhere by not impeding the flow of flood water, reducing storage capacity of the floodplain. Details of flood mitigation measures to reduce the impact of flooding on the proposed development and ensure that the proposed development does not result in an increase in maximum flood levels within adjoining properties should be provided. 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, hydraulically linked compensatory flood

[57] An article 4 direction is a direction under article 4 of the General Permitted Development Order which enables the Secretary of State or the local planning authority to withdraw specified permitted development rights across a defined area.

storage is provided within the site (or upstream), and/or the incorporation of floodable voids (more information will be provided in the Level 2 SFRA). It is acknowledged that full compensation may not be possible on all minor developments, however, an applicant must be able to demonstrate that every effort has been made to achieve this and provide full justification where this is not the case.

12.3.6 Changes of Use

Where a development undergoes a change of use and the vulnerability classification of the development changes, there may be an increase in flood risk. For example, changing from industrial use to residential use will increase the vulnerability classification from Less to More Vulnerable (Table 8-2).

For change of use applications in Flood Zone 2 and 3, applicants must submit a FRA with their application. This should demonstrate how the flood risks to the development will be managed so that it remains safe through its lifetime including provision of safe access and egress and preparation of Flood Warning and Evacuation Plans where necessary. Further guidance will be provided within the Level 2 SFRA Report.

As changes of use are not subject to the Sequential or Exception Tests, the London Boroughs should consider when formulating policy what changes of use will be acceptable, having regard to paragraph 157 (6th bullet) of the NPPF: "identify areas where it may be necessary to limit freedom to change the uses of buildings, and support such restrictions with a clear explanation" and taking into account the findings of this SFRA. This is likely to depend on whether developments can be designed to be safe and that there is safe access and egress.

12.3.7 Basement Development

Basement development may involve either the extension of an existing habitable basement under a house, or the construction of a completely new basement. London boroughs, especially Wandsworth and Merton, have experienced an increase of basement and subterranean developments over the last 5 years. It is becoming increasingly popular to construct basements which extend beyond the footprint of the host property and under the amenity area.

In accordance with the PPG, self-contained dwellings or bedrooms at basement level in Flood Zone 3 should not be permitted due to the vulnerability of users. Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units are not acceptable in Flood Zone 3b. Basements for other uses in Flood Zone 3a and 2 may be granted provided there is a safe means to escape via internal access to higher floors 300mm above the 1% annual probability (1 in 100 year) flood level including an allowance for climate change.

The BGS Susceptibility to Groundwater Flooding maps provided in **Appendix A Figures 2.4, 3.4, 4.4 and 5.4** should be used to help assess the suitability of potential basement developments. Basement dwelling are not considered appropriate in areas that have 'potential for groundwater to occur at the surface'. However, it should be made clear that the Susceptibility to Groundwater Flooding maps are high level strategic maps and even though there are areas of no risk is mapped it does not mean that there is no risk present. Therefore, it is recommended that ground investigations and groundwater monitoring should be undertaken at each potential basement development site.

Basement development may affect groundwater flows, and even though the displaced water will find a new course around the area of obstruction this may have other consequences for nearby receptors e.g. buildings, trees. If basement development is located within an aquifer corridor, it may lead to localised elevations in groundwater and increase flood levels. An FRA must provide details of an appropriate sustainable urban drainage system for the site and investigation to determine whether a perimeter drainage system or other suitable measure is necessary to ensure any existing sub-surface water flow regimes are not interrupted.

The FRA must also address the impact of the proposed extension on the ability of the floodplain to store floodwater during the 1% annual probability (1 in 100 year) event including allowance for climate change and where necessary provide compensatory floodplain storage on a level for level, volume for volume basis.

Basement Impact Assessments:

Merton is currently producing a Basement Development SPD which provides guidance on the planning policies, planning guidance and regulations that apply in reference to basement development in Merton. It draws upon relevant national, regional and local authority requirements and expectations for sustainable development and good practice.

However as a means of best practise where basements are proposed, a Basement Impact Assessment should be requested by the local authority to help assess the flood risks to the basement development.

Basement Impact Assessments (BIA) are required to be undertaken for any basement application. These are to be informed by ground investigations (boreholes/trial pits) to assess groundwater level/flow, land and structural stability and recommend monitoring is undertaken post approval. The BIA should be prepared by a structural engineering or hydrology firm that is fully accredited by the main professional institute(s) and therefore whose advice the Council could accept as independent.

13 Next Steps

13.1 Sequential Test

Using the strategic flood risk information presented within this Level 1 SFRA, each Borough should undertake the Sequential Test to document the process whereby future development is steered towards areas of lowest flood risk.

13.2 Level 2 SFRA

Where it is not possible to accommodate all the necessary development outside those areas identified to be at risk of flooding, a Level 2 SFRA will be required to provide information to support the application of the Exception Test for future development sites. The scope of the Level 2 SFRA will be to consider the detailed nature of the flood characteristics within a flood zone including:

- flood probability;
- flood depth;
- flood velocity;
- rate of onset of flooding; and
- duration of flood.

The Level 2 SFRA will be delivered as four separate documents for each of the London Boroughs. The Level 2 SFRA will provide a more detailed assessment of the flood risk for specific development sites which may require the application of the Exception Test.

13.3 Future Updates to the SFRA

This SFRA has been updated building heavily upon existing knowledge with respect to flood risk within the four Boroughs. The Environment Agency review and update the Flood Map for Planning (Rivers and Sea) on a quarterly basis and a rolling programme of detailed flood risk mapping is underway. Future new modelling of watercourses in the area will improve the current knowledge of flood risk within each Borough, and may marginally alter predicted flood extents within parts of the Boroughs in the future.

New information may influence future development management decisions within these areas. Therefore it is important that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives, flood risk datasets and an improving understanding of flood risk within the four Boroughs.

Areas in which each Borough could look to improve their understanding of flood risk include detailed mapping of their ordinary watercourses and working closely with Thames Water to understand local sewer capacity issues. It is recommended that the Drainage Catchments identified in this SFRA should be used to locate strategic SuDS measures to manage surface water runoff as close to the source as possible.

13.3.1 Checklist on factors to trigger an update to the SFRA

The checklist below provides examples of when an update to the Level 1 SFRA may be required.

1. A significant flood event occurs, following which relevant information should be detailed within an addendum to the Level 1 SFRA. The following information should be included:
    - The mapped extent of the flooding;
    - The date on which the event occurred;
    - The source of the flooding;
    - If known, the return period of the flood event – the likelihood of an event of the same magnitude occurring in any given year;
    - Any amendments to Flood Zone 2 and 3 carried out by the Environment Agency as a result of the flooding.

2. The NPPF or PPG are amended, with subsequent impacts on the approach to flood risk, for example:
    - An amendment is made to the application of the Sequential or Exception Test;
    - An amendment is made to the definition of fluvial flood zones;
    - Land use vulnerability definitions, presented in the PPG, are amended;
    - The approach to management of SuDS is amended.

3. The Environment Agency releases updates or amendments to its detailed modelling of the River Wandle, Beverley Brook, River Thames, or amends its standing advice. An update would be required if:
    - Updates to the River Wandle, Beverley Brook, River Thames models alter the 1 in 20 year plus climate change (defended), 1 in 100 year (undefended), 1 in 100 year plus climate change (defended) or 1 in 1000 year (undefended) outline. If this is the case Flood Zone 3b, Flood Zone 3, Flood Zone 3 with climate change and Flood Zone 2 should be re-mapped within the Level 1 SFRA;
    - If any other flood risk data is updated, such that the SFRA does not provide the most relevant and up-to-date information;
    - Environment Agency standing advice is altered so that it is no longer in-line with Flood Risk Management Policy Considerations, or other guidance within this Level 1 SFRA. Should this be the case, it is recommended that the Environment Agency is consulted.

Appendix A. Figures

Figure 1.0 Study Area

London Borough of Croydon

Figure 2.1 Flooding from Rivers – Flood Zones
Figure 2.2 Updated Flood Map for Surface Water
Figure 2.3 Drainage Catchments and uFMfSW
Figure 2.4 Susceptibility to Groundwater Flooding
Figure 2.5 Sewer Flooding
Figure 2.6 Flood Warning Areas

London Borough of Merton

Figure 3.1 Flooding from Rivers – Flood Zones
Figure 3.2 Updated Flood Map for Surface Water
Figure 3.3 Drainage Catchments and uFMfSW
Figure 3.4 Susceptibility to Groundwater Flooding
Figure 3.5 Sewer Flooding
Figure 3.6 Flood Warning Areas

London Borough of Sutton

Figure 4.1 Flooding from Rivers – Flood Zones
Figure 4.2 Updated Flood Map for Surface Water
Figure 4.3 Drainage Catchments and uFMfSW
Figure 4.4 Susceptibility to Groundwater Flooding
Figure 4.5 Sewer Flooding
Figure 4.6 Flood Warning Areas

London Borough of Wandsworth

Figure 5.1 Flooding from Rivers – Flood Zones
Figure 5.2 Updated Flood Map for Surface Water
Figure 5.3 Drainage Catchments and uFMfSW
Figure 5.4 Susceptibility to Groundwater Flooding
Figure 5.5 Sewer Flooding
Figure 5.6 Flood Warning Areas
Figure 5.7 Tidal Breach Model Hazard Mapping for the Maximum Likely Water Level (MLWL) for the Year 2014
Figure 5.8 Tidal Breach Model Hazard Mapping for the Maximum Likely Water Level (MLWL) for the Year 2065
Figure 5.9 Tidal Breach Model Hazard Mapping for the Maximum Likely Water Level (MLWL) for the Year 2100

Appendix B. Sustainability Appraisal Objectives

Table B-1 London Borough of Croydon Sustainability Appraisal Objectives[58]

Sustainability Objectives		Guide Questions
1	To reduce crime, opportunities for crime and fear of crime	Will it reduce levels of crime? Will it reduce levels of anti-social behaviour? Will it reduce the fear of crime? Will it encourage safety by high quality design? Will it improve the provision and access to community, cultural, leisure and recreational facilities throughout the borough to target young and other potential offenders?
2	To improve provision and access to educational facilities for all groups within the community.	Will it increase levels of participation and attainment in education for all members of society? Will it increase levels of participation in higher or further education and training? Will it improve the provision and access to education and learning facilities?
3	To improve health and wellbeing for all and reduce health inequalities.	Will it improve access to health and social care services? Will it ensure there are sufficient facilities and opportunities to ensure good health and well-being? Will it promote healthy lifestyles? Will it reduce health inequalities? Will it reduce death rates?
4	To provide greater choice and an appropriate mix of housing in terms of size, type and location.	Will it reduce homelessness? Will it increase the availability of affordable housing? Will it encourage mixed use and range of housing tenure? Will it reduce the number of unfit housing?
5	To ensure equal and fair access to opportunities, services and amenities, focusing on the most deprived areas.	Will it provide more equal access to opportunities? Will it improve access to community, cultural, and leisure and recreational facilities? Will it improve provision of community, cultural, leisure and recreational facilities, resources and events to take account of Croydon's diversity? Will it ensure public art is integrated into key developments? Will it maintain and improve access to essential services (banking, health and education), particularly in disadvantaged areas? Will it enable and promote social inclusion, cohesion and diversity?
6	To protect and enhance community spirit and cohesion.	Will it foster a sense of belonging? Will it provide opportunities for community involvement? Will it improve ethnic/cultural relations?
7	To ensure sustainable economic growth and business development to provide economic well-being for all of the community.	Will it encourage new businesses and opportunities for local people? Will it improve business development and enhance productivity? Will it encourage diversification of employment opportunities? Will it enhance the image of the area as a business location?

[58] London Borough of Croydon, August 2011, Core Strategy Sustainability Appraisal

8	To ensure that employment opportunities are accessible and meet the needs of residents.	Will it reduce levels of unemployment? Will it provide learning opportunities and work related training? Will it support flexible working patterns? Will it help improve earnings?
9	To promote economic vitality.	Will it promote the town, district and local centres as places to work, live and visit? Will it contribute to local regeneration and help deprived areas?
10	To protect and enhance biodiversity and existing habitats and seek to increase these, if possible.	Will it conserve, restore and enhance priority habitats and habitats of metropolitan, borough or local importance and create viable habitats in areas of deficiency? Will it conserve and enhance species diversity and avoid harm to priority and protected species? Will it provide opportunities for habitat creation? Will it provide multi-user paths linking existing and planned open spaces and rights of way? Will it contribute to biodiversity, such as green roofs and creation of new green spaces? Will it help to achieve biodiversity action plan targets?
11	To ensure that a network of diverse, good quality open spaces is provided.	Will it ensure that open spaces are accessible to all and meet the community's needs? Will it ensure that provision and access to sport and play facilities in open spaces are available to all community groups? Will it provide opportunities for people to come into contact with and appreciate wildlife and green spaces? Will it provide multi-user paths linking existing and planned open spaces and rights of way?
12	To retain, conserve and enhance the valued townscape and landscape features.	Will it maintain and enhance the quality of landscape features in towns and suburbs? Will it minimise visual intrusion and protect views? Will it enhance the townscape and public realm? Will local design qualities and the role and key characteristics of place be emphasised?
13	To protect and enhance the borough's cultural and heritage resources.	Will it protect and enhance Conservation Areas and other sites, features and areas of historical and cultural value? Will it protect listed buildings? Will it help preserve archaeological features? Will it enhance the townscape and public realm?
14	To improve, protect and manage water quality and conserve water resources	Will it protect ground and surface water quality? Will it promote efficient use of water supplies? Will it promote developments to use water supplies in an efficient and sustainable manner?
15	To reduce flood risk and adapt to climate change.	Will it reduce the risk of flooding from rivers and watercourses? Will it reduce the risk of damage to property from storm events? Will it promote the use of sustainable drainage? Will it reduce the risk of flooding from surface and ground water?
16	To protect and improve air quality.	Will it improve air quality within the borough? Will it help achieve the objectives of the Air Quality Action Plan? Will it reduce emissions of key pollutants, particularly in town centres?
17	To reduce energy consumption and promote energy efficiency.	Will it reduce emissions of greenhouse gases by reducing energy consumption? Will it lead to an increase in energy efficiency and the proportion of energy needs being met from renewable sources?
18	To promote efficient and prudent use of land and natural resources and promote waste minimisation.	Will it promote the efficient use of land resources, including brownfield land, buildings and infrastructure? Will it cause the risk of land contamination to increase? Will it lead to reduced consumption and efficient supply and use of raw materials and resources? Will it reduce waste production? Will it increase waste re-use, recycling and recovery?

19	To promote sustainable construction and design.	Will it promote the use of high quality design, sustainable materials and construction methods? Will it ensure that new buildings and landscapes are appropriately located, sustainably designed and constructed to take account of climate change adaptation? Will it promote adaptable, durable and inclusive developments? Will it ensure environmental impacts of buildings are minimised?
20	To encourage efficient patterns of movement and promote sustainable modes of transport.	Will it facilitate access to key services, jobs and facilities? Will it reduce traffic? Will it ensure that transport infrastructure and facilities provide safe, equal and fair access to all the community? Will it provide infrastructure to improve accessibility to work by public transport, walking and cycling or riding? Will it reduce journey times between key employment areas and key transport interchanges? Will it reduce air pollution and to ensure ambient air quality improves? Will it encourage businesses and other organisations to produce travel plans? Will it encourage car free developments and developments where parking spaces are limited per household?

Table B-2 London Borough of Merton Sustainability Appraisal Objectives[59]

Sustainability Objectives	Key Issues	Indicators, Targets, Objectives
Climate Change	Climate change is a threat to the lifestyles of Merton residents and to wildlife, cultural heritage and material assets. It is predicted that higher temperatures and lower rainfall may be experienced in the south east. In addition to drinking water shortages, falling groundwater levels could lead to increased risk of subsidence and, where heavy rain falls on a parched ground in late summer the risk of flooding could increase. Green roofs and rain water harvesting.	Planning to adapt to climate change seeks to embed the management of climate change by • assessing risks and opportunities; • taking action in any identified priority areas; • develop an adaptation strategy and action plan; and • Implement, assess and monitor the actions on an ongoing basis. Evidence will be required that the local authority has put in place a mechanism for proactively managing climate risks and opportunities in their decisions, plans and measures on the ground.
Energy and carbon reduction	Merton has been in the forefront for developing strategy for carbon reduction and is eager to build on this progress by focussing on carbon reduction from new developments and also from other energy saving initiatives via Merton's Climate Change strategy. Furthermore, design measures introduced to address climate change will also help improve energy efficiency and energy from waste schemes can also help to reduce carbon.	Ensure specific measures to improve energy efficiency and reduce greenhouse gas emissions are used in new developments, refurbishment and/or renovations and extensions. Use sustainable energy systems as widely as possible. Improve the energy performance and reduce emissions from dwellings within Merton.
Biodiversity	Merton has a rich wealth of habitats and species that are protected from development and climate change and enhanced where possible. The London Plan seeks improved quality of the public realm and to see the creation a new regional park that integrates and contributes to the regeneration of the Wandle Valley Development Corridor.	Further protect and enhance all existing designated sites. Reduce the area of the borough deficient in access to areas of natural greenspace.
Access to nature and open space	Merton enjoys an excellent provision of open space especially existing commons (Wimbledon and Mitcham) and along the river Wandle but there is scope for increasing the opportunity for contact with nature and open space and; improving the quality of the public realm. The creation of the Wandle Valley Regional Park within London's Green Grid will help improve access to nature and open space as well as create recreation opportunities.	Improve the access to and quality of open spaces. Conserve and protect existing trees against damage and unnecessary removal.
Noise	The Department for Environment Food and Rural Affairs (DEFRA) has produced a strategic noise map for major airports, roads and railways in London and the council will have regard to this information, the council will also have regard to the Noise Action Plan for London and the Mayor of London's Ambient Noise Strategy. Theses mapping identifies areas in Merton where noise levels need to be managed. The priorities in Merton are the following along the A3 Kingston-by-pass, Plough Lane/Haydons Road junction, Cricket Green and South Wimbledon junction.	To manage and control the impact of noise and vibration for local residents including those developments that are noise sensitive developments (including schools, hospitals and housing).

[59] London Borough of Merton, January 2013, Sustainability Appraisal Report (Incorporating Environmental Report), Preferred Options Stage 3

Waste	There is a need to identify new facilities to accommodate a move away from land filling waste. The South London Waste Plan aims to divert 100% of waste from landfill will make a major contribution to this. In Merton there is a need to manage waste sustainably via energy from waste that will also contribute to mitigating against climate change and energy and carbon reduction (see above)	Promote waste minimisation by re-use and recycling in line with reducing net carbon emissions and the European waste hierarchy, and to recover the maximum value from residual waste by increasing energy derived from residual waste.
River and water quality use, resources and wastewater infrastructure	Climate change, population growth and lifestyle choices are increasing the amount of water used and affecting the quality of the river Wandle, Beverly Brook and their tributaries.	Reduce water pollution and improve water quality and resources in river Wandle and Beverly Brook. Improvement of the biological and chemical status of the River Wandle and Beverly Brook to good by 2027 (Environment Agency).
Flooding	Merton experiences flooding from a number of sources especially fluvial flooding from the river Wandle, Beverly brook and their tributaries. Surface water and critical drainage problems are also an issue in some isolated parts of the borough.	Reduce the flood risk to people and property from all sources of flooding including surface water flooding. Compliance with Flood and Water Management Act 2010
Air quality	Air quality is improving in Merton but there is further scope to reduce atmospheric pollution across the borough buildings.	Ensure the risks of pollution to human health and all areas of the boroughs environment are reduced
Land use	Merton is a highly urbanised area and development should be prioritised in town and local centres; on previously developed land and with good transport and community facilities accessibility.	Increase the use of urban brownfield land (Use Brownfield land efficiently)
Access to culture, leisure and social activities	Opportunities for culture, leisure and recreation need to be readily available to all in Merton, building on existing facilities in the borough and capitalising on Merton's role in the Olympics and the legacy after the games.	Improve the access to and quality of open spaces. Improve access to cultural and leisure facilities.
The built and heritage environment	Merton has a number of statutory and locally listed buildings within the borough. It is important that any development is sensitive to Merton's historical assets. Improving, understanding and value of historical assets in Merton.	Reduce heritage buildings at risk on English Heritage at Risk Register. No loss of Listed Building (local and statutory) and Historic Parks and gardens. Protect and enhance the boroughs archaeological heritage (including remains) and historical assets (including walls and graveyards).
Transport	Accessibility to key services, facilities, employment, goods and other amenities is uneven across Merton; with some areas east of the borough having poor transport links to their local centre and essential amenities. Sustainable transport in Merton has improved over the years. It is essential that this is built upon in Merton	Meet Merton's target of reducing transport CO2 emissions by 45% by: • Reduce the need to travel by car • Increase the use of sustainable transport modes including walking and cycling
Health and well being	There are large disparities in health and well-being across the borough namely in the east of the borough which has a higher	Improve health equality and access to health and well-being facilities. Encourage regular participation in sport and recreation
Poverty and social inclusion	There are clear disparities in income, access to social and community and; infrastructure between the eastern and western part of the borough.	Ensure everyone has access to basic services. Alleviate the risk of fuel poverty or reduce the number of people living in fuel poverty.
Diversity and equality	Merton has a wide cultural, ethnic, faith based and racial diversity.	Promote equality where a vibrant socially inclusive community is encouraged.
Crime and fear of crime	Building on Merton's historical low crime figures. Creating safer and secure communities for all in the borough.	Maintain low rates of crime and reduce fear of crime.
Housing	Currently in Merton there is a difference in affordability, level of provision, quality, environmental performance, design and	Housing Target • Meet housing need (320 units per year)

Affordable housing	distribution of housing within the borough. The London Plan and Merton local plan seek to deliver housing provision complemented by adequate social and other infrastructure and that the reuse of surplus industrial land is managed. The provision of affordable is a priority.	Affordable Housing • 10 units and above: 40% on site • between 1-9 units: 20% cash in lieu to create additional affordable homes
Education and skills	There is a disparity of skills and employment in the borough. Namely higher level of non-educational achievement or attainment and training in the east of the borough.	Increase opportunities to education and training Number of pupils getting grades A-C at GCSEs (www.dcsf.gov.uk) Improve the potential to enable more employment options and training in the borough.
Work and economy	There are disparities in employment levels in the between the east and west of the borough, with east having lower employment levels, range of employment and employment opportunities.	Provide employment land and support access to employment. Number and proportion of economically active employed and number and proportion of people unemployed (www.nomisweb.co.uk)

Table B-3 London Borough of Sutton Sustainability Appraisal Objectives[60]

Sustainability Objectives	
(A) Environmental sustainability	**1. Climate Change Mitigation** To address the causes of climate change by minimising CO_2 emissions from new development **2. Flood Risk and Climate Change Adaptation** To avoid, reduce and manage flood risk **3. Pollution and Natural Resources** To conserve natural resources and minimise pollution **4. Biodiversity** To protect and enhance biodiversity, habitats and green corridors within the Borough
(B) Sustainable Economic Growth	**5. Economic Growth and Inward Investment** To attract inward investment and promote sustainable growth in support of Sutton's Economic Development Strategy **6. Employment** To promote local employment opportunities, skills and training within the Borough. **7. Town Centres** To enhance the vitality and viability of town centres **8. Area Renewal** To secure inward investment for area renewal programmes to deliver environmental business improvements.
(C) Sustainable Communities	**9. Access to Housing** To meet the future local need for housing and the Borough's share of London's need. **10. Access to Education and Health** To ensure access to education facilities and health for all. **11. Access to Sport and Leisure Facilities** To ensure access to Sport and Leisure Facilities for all. **12. Sustainable Transport** To reduce traffic levels, congestion, local air pollution and CO_2 emissions from transport
(D) Quality of Life and Equalities	**13. Open Environment** To protect and enhance the provision and quality of the Borough's open environment. **14. Built and Historic Environment** To protect and enhance the quality of the built design, townscape quality and the historic environment. **15. Social Deprivation, Health Deprivation and Fuel Poverty** To reduce social deprivation, health deprivation and fuel poverty. **16. Equalities, Accessibility and Social Inclusion** To reduce social exclusion, address inequalities and improve accessibility to essential services and community facilities for all.

[60] London Borough of Sutton, July 2015, Local Plan, Sustainability Appraisal Scoping Report

Table B-4 London Borough of Wandsworth Sustainability Appraisal Objectives[61]

	Sustainability Issues	Sustainability Objectives
Environment	**Pressure on the natural and built environment** Sub issues: • Pressure or development on greenfield sites • Increased number of listed buildings at risk • Some priority species in decline • Loss of wildlife habitats **Waste reduction and sustainable waste management** Sub issues: • Increased volume of waste • Increase in amount of municipal waste • Requirement to reduce the amount of waste sent to landfill • Requirement to identify sufficient waste management facilities in line with waste hierarchy. **Climate change and air quality** Sub issues: • Potential flood risk • Detrimental traffic emissions upon air quality • Increased volume of waste	1. Protect the built heritage of the borough 2. Avoid loss of greenfield sites 3. Protect and enhance the natural environment and biodiversity of the borough 4. Minimise the production of waste and encourage recycling 5. Maintain and improve air quality 6. Conserve energy and resources 7. Reduce the impact of noise 8. Minimise flood risk in the borough and elsewhere and promote the use of SuDS 9. Encourage use of renewables in order to mitigate climate change
Social	**Population and household growth and housing demand and supply** Sub issues: • Population is projected to increase • High demand for housing but many priced out of the market **Access to essential community services** Sub issues: • Pockets of deprivation **Pockets of deprivation and social crime** **exclusion** Sub issues: • Lower percentage of pupils in local authority schools achieving 5 or more A*-C grade GCSEs than the national average **Public health** Sub issues: • Lower than average life expectancy • Higher than average mortality ratio • Teenage conception rate higher than national average • Around a third of residents living in open space deficiency areas • Increasing numbers of noise complaints from noise emitted from construction sites	10. Ensure people have access to suitable housing 11. Ensure people have access to essential community services and facilities 12. Reduce the need to travel 13. Ensure people have access to suitable employment opportunities 14. Protect and improve public health 15. Reduce crime and fear of crime 16. Reduce poverty, social exclusion and health inequalities 19. Ensure equality for everyone regardless of disability, race/ethnicity, age, sexuality, religion or belief *(added at a later stage of the adopted Core Strategy following identification of the issue in the Equality Impact Assessment).*

[61] London Borough of Wandsworth, October 2014, Wandsworth Local Plan Sustainability Appraisal (2nd proposed submission version)

Economic	**Traffic congestion and lack of public transport infrastructure** Sub issues: • Significant traffic congestion on the main road network **Mismatch of supply and demand for business premises** Sub issues: • Limited amount of flexible, modern, affordable business accommodation Characterised by small firm economy **Ensuring vitality and viability of existing town centres and important parades** Sub issues: • Range of employment types • Mix of retail and non-retail uses **Balancing the competing demands of Nine Elms Opportunity area**	17. Encourage the growth of sustainable transport 18. Promote and encourage economic investment

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