SURFACE WATER MANAGEMENT PLAN

DRAIN LONDON

GREATERLONDONAUTHORITY

Thames Water

LONDON COUNCILS

Environment Agency

LONDON
BOROUGH OF
SUTTON

Sutton

Quality Management

DOCUMENT INFORMATION

Title:	SWMP for London Borough of Sutton
Owner:	Gerry McLaughlin, Patrick Whitter, Mark Dalzell
Version:	V0pt2
Status:	Final
Project Number:	D134786
File Name:	DLT2-GP8-SWMP-Sutton-Report-V0pt2-FINAL.doc

REVISION HISTORY

Summary of Changes	Completed By	Date of Issue	Version
Draft Report (v0.1) updated with Sutton Borough Council, GLA and Peer Review Comments	Sarah Littlewood	16/09/2011	V0pt2

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RELATED DOCUMENTS

Doc Ref	Document Title	Author	Date of Issue	Version
GP8-PFRA-Sutton	PFRA for London Borough of Sutton	URS/Scott Wilson	June 2011	1.0

Executive Summary

This document forms the Surface Water Management Plan (SWMP) for the London Borough of Sutton which has been delivered as part of the Tier 2 package of works of the Drain London Project. This document is a plan which outlines the preferred surface water management strategy for the London Borough of Sutton including consideration of flooding from sewers, drains, groundwater and runoff from land, ordinary watercourses and ditches that occurs as a result of heavy rainfall.

The SWMP builds upon previous work undertaken with the Borough, including the Phase 1 and 2 SWMP prepared by URS Scott Wilson in 2010, and has been undertaken following a four phase approach; Phase 1 – Preparation; Phase 2 – Risk Assessment; Phase 3 – Options; and Phase 4 – Implementation and Review.

Phase 1 Preparation

Phase 1 builds upon work formerly undertaken during Tier 1 of the Drain London Project (as well as the original Phase 1 and 2 SWMP completed in 2010) to collect and review surface water data from key stakeholders and build partnerships between stakeholders responsible for local flood risk management. As part of the phase of work, London Borough of Sutton has continued to actively forge partnerships with the Environment Agency and Thames Water through the Sutton Flood Group and has also begun to establish a broader partnership with neighbouring London Boroughs in south west London in order to share resources and best practice to enable each local authority to discharge their responsibilities as Lead Local Flood Authority (LLFA) under the Flood and Water Management Act (FWMA) 2010.

Phase 2 Risk Assessment

As part of Phase 2 Risk Assessment, pluvial modelling has been undertaken across the entire Borough for five specified return periods, using a uniform methodology agreed by the Drain London Programme Board for the whole of the Greater London Authority area. The results of this modelling have been used to identify Local Flood Risk Zones (LFRZs) within the Borough, where flooding affects houses, businesses or infrastructure. Those areas identified to be at more significant risk have been delineated into Critical Drainage Areas (CDAs) representing one or several LFRZs as well as the contributing catchment area and features that influence the predicted flood extent.

Figure 1 – Critical Drainage Area Index Map & Surface Water Flood Depth (1% AEP)

Within the London Borough of Sutton, twelve (12) CDAs have been identified; these are shown in Figure 1. The chief mechanisms of flooding can be summarised by dividing the Borough in half from east to west. In the south of the Borough, 7 CDAs have been delineated where surface water is modelled to flow down steep catchments and pond in topographical low points, primarily behind or underneath railway embankments, reaching depths of greater than 0.5m.

In the north of the Borough where the topography is less steep, 5 CDAs have been delineated. These CDAs have linkages with the fluvial systems of the River Wandle, the Beverley Brook and the Pyl Brook and the areas of flooding are typically of greater extent than those in the southern part of the Borough. High groundwater levels and the limited capacity of the Thames Water surface water sewer network in these CDAs, most notably Hackbridge and Beddington Park, also contribute to the complex and interlinked mechanisms of flooding within these CDAs.

Analysis of the number of properties at risk of flooding has been undertaken for the rainfall event with a 1 in 100 annual probability of occurring in any given year (1% AEP). A review of these statistics coupled with local knowledge of the study area identifies that the following CDAs are at greatest risk of flooding in terms of the number of receptors at risk:

Table 1 Critical Drainage Areas at greatest risk in London Borough of Sutton

CDA ID & Name	No. of infrastructure / properties at risk of flooding during 1% AEP event rainfall event.						
	Infrastructure (PPS25 Categories)			Households		Commercial	
	Essential	Highly Vulnerable	More Vulnerable	Non-Deprived	Non-Deprived (Basements)	All	Basements
Group8_023 Trafalgar Ave	2	0	3	2378	0	102	0
Group8_026 Sutton Junction	7	0	8	2113	0	49	0
Group8_022 Worcester Park	4	1	5	1915	10	139	20
Group8_033 Hackbridge	1	0	2	1023	0	68	0
Group8_028 Carshalton Centre	0	0	6	975	0	68	0

Across the Borough as a whole, 3 fire and ambulance stations, 9 police stations, 3 hospitals, 72 electricity substations, 21 residential care homes and 106 educational establishments are identified to be at risk of flooding from surface water during the 1% AEP event.

CDA_026 Worcester Park and CDA_027 Trafalgar Avenue in the north west of the Borough cross into the administrative areas of London Borough of Merton, Royal Borough of Kingston and Surrey County Council, and will need to be jointly managed to implement the potential options and manage surface water flood risk in these areas.

Phase 3 Options Assessment

There are a number of opportunities for measures to be implemented across the Borough to tackle surface water flood risk. Ongoing maintenance of the drainage network and small scale improvements are already undertaken as part of current operations of the Borough. In addition, opportunities to raise community awareness of the risks and responsibilities for residents and businesses should be sought, and London Borough of Sutton is seeking to implement a Communication Plan within the next financial year to assist with this.

Two Policy Areas have been delineated for the Borough; Policy Area North and Policy Area South. Within these Policy Areas there are opportunities for generic measures to be implemented through the establishment of a policy position on issues including the widespread use of water conservation measures such as water butts and rainwater harvesting technology and use of SuDS. In addition, there are Borough-wide opportunities to raise community awareness, look at opportunities to increase resilience to flooding and improve targeted drainage network maintenance.

For each of the CDAs identified within the Borough, site-specific measures have been identified that could be considered to help alleviate surface water flooding. These measures were subsequently shortlisted to identify a potential preferred option for each CDA.

For the purposes of this SWMP, areas in which the predominant source of flooding is Main Rivers have not been taken forward for consideration of capital schemes, given that flooding from fluvial sources is not the focus of a SWMP and the primary responsibility for Main River flooding is that of the Environment Agency. This includes the CDAs for Worcester Park, Trafalgar Avenue and Hackbridge. In these areas it is essential that London Borough of Sutton continue to work with the Environment Agency as they (the Environment Agency) seek to lead on flood risk management associated with Main Rivers.

As a result, three options for immediate consideration within London Borough of Sutton include:

A) Critical Drainage Area Group8_033 Hackbridge

The preferred option for this CDA includes a feasibility study to consider the potential benefits of de-culverting the ordinary watercourse in Mill Green, Hackbridge. This scheme has been identified within the Draft Hackbridge Climate Change Adaptation Plan. Proposals include a suite of landscape treatments for Mill Green in the northern part of the CDA including permeable paving, de-culverting the watercourse, creating shallow hollow areas for water storage, as well as creating water meadow grassland and water's edge planting.

In addition, it is recommended that an investigation is undertaken in conjunction with Thames Water to identify the capacity of the local drainage system in this area and to prioritise future improvements to the drainage infrastructure. Each of these studies are within the cost band <£25K.

B) Critical Drainage Area Group8_026 Sutton Junction

The preferred option for this CDA is to undertake investigations into the capacity of the Thames Water surface water sewer system at Wellesley Road and Cedar Road and to consider the removal or realignment of the 90° bend in the surface water sewer at Cedar Road and replacement with a new length of surface water sewer. This will increase the capacity and efficiency of this sewer and alleviate localised surcharging of the system.

In tandem with this, further study into the provision of a flood storage area and connecting swales within the eastern part of Overton Grange School sports field could also be considered.

C) Critical Drainage Area Group8_028 Carshalton Centre

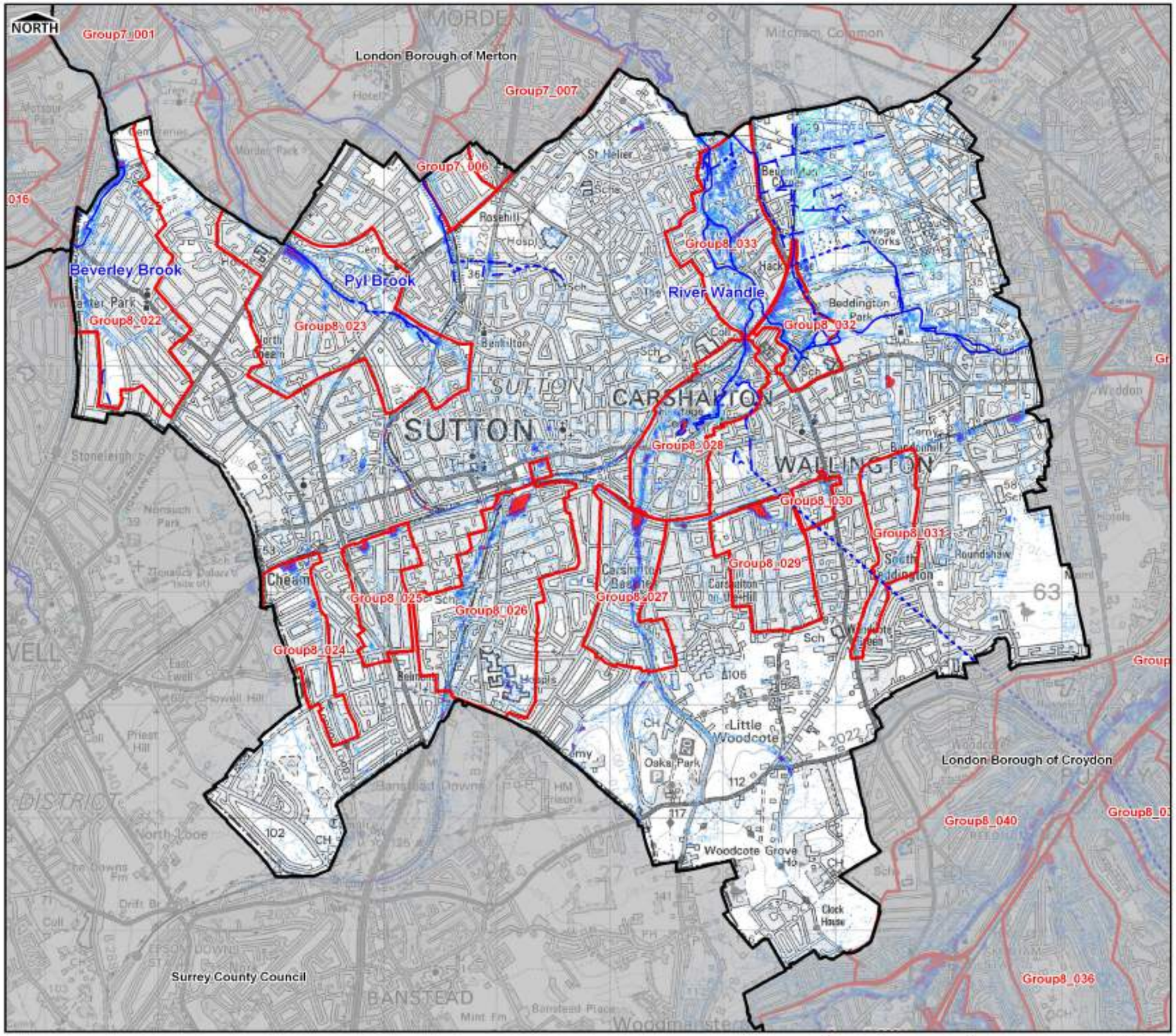
The preferred option for this CDA is further study into the potential for the creation of flood storage areas in the playing fields adjacent to The Grove Recreation Ground. Flood storage, of approximate volume 10,000m3, could be provided, with a connecting swale running north eastwards from High Street and North Street towards the storage area. A scheme such as this could provide mitigation to local properties and the primary transport route through Mill Lane. The cost of this preferred option is in the capital cost band of £251K - £500K.

Phase 4 Implementation & Review

Phase 4 establishes a long-term draft Action Plan for London Borough of Sutton to assist in their role under the FWMA to lead in the management of surface water, groundwater and ordinary watercourse flood risk across the Borough. The purpose of the draft Action Plan is to;

1. Outline the actions required to implement the preferred options identified in Phase 3;
2. Identify the partners or stakeholders responsible for implementing the action;
3. Provide an indication of the priority of the actions and a timescale for delivery; and,
4. Outline actions required to meet the requirements for London Borough of Sutton as LLFA under the FWMA.

The draft Action Plan (included in Appendix I) is a 'living' document, and as such, should be reviewed and updated regularly, particularly following the occurrence of a surface water flood event, when additional data or modelling becomes available, following the outcome of investment decisions by partners and following any additional major development or changes in the catchment which may affect the surface water flood risk.



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- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Body
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:35,000	20/07/11	S.LITTLEWOOD	J.ROBINSON

Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

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FIGURE 1

Filepath: N:\Water\Current Projects\D1347\85 D1347\86 DRAIN LONDON Tier 2\02 Group 8 (D1347\86\05 GIS

Glossary

Term	Definition
AEP	Annual Exceedance Probability
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
AMP	Asset Management Plan
Asset Management Plan	A plan for managing water and sewerage company (WaSC) infrastructure and other assets in order to deliver an agreed standard of service.
AStSWF	Areas Susceptible to Surface Water Flooding
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CDA	Critical Drainage Area
Critical Drainage Area	A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan
CIRIA	Construction Industry Research and Information Association
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances including flooding.
CLG	Government Department for Communities and Local Government
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Culvert	A channel or pipe that carries water below the level of the ground.
Defra	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
DTM	Digital Terrain Model
EA	Environment Agency
Indicative Flood Risk Areas	Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and WAG and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs.
FMfSW	Flood Map for Surface Water
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Hazard	The derivation of flood hazard is based on the methodology in Flood Risks to people FD2320 using and is a function of flood depth, flow velocity and a debris factor.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG.
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRR2009	Flood Risk Regulations 2009
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
LB	London Borough
LDF	Local Development Framework

Term	Definition
LFRZ	Local Flood Risk Zone
Local Flood Risk Zone	Local Flood Risk Zones are defined as discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area' but still affect houses, businesses or infrastructure. A LFRZ is defined as the actual spatial extent of predicted flooding in a single location
Lead Local Flood Authority	Local Authority responsible for taking the lead on local flood risk management
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority
Local Resilience Forum	A multi-agency forum, bringing together all the organisations that have a duty to cooperate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a co-ordinated manner.
LPA	Local Planning Authority
LRF	Local Resilience Forum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NRD	National Receptor Dataset – a collection of risk receptors produced by the Environment Agency
Ordinary Watercourse	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, IDBs
Partner	A person or organisation with responsibility for the decision or actions that need to be taken.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial Flooding	Flooding from water flowing over the surface of the ground; often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with additional flow.
PPS25	Planning and Policy Statement 25: Development and Flood Risk
PA	Policy Area
Policy Area	One or more Critical Drainage Areas linked together to provide a planning policy tool for the end users. Primarily defined on a hydrological basis, but can also accommodate geological concerns where these significantly influence the implementation of SuDS
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority	As defined by the Floods and Water Management Act
RMA	Risk Management Authority
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems
Sustainable Drainage Systems	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Surface water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
SWMP	Surface Water Management Plan
TfL	Transport for London
TWUL	Thames Water Utilities Ltd
WaSC	Water and Sewerage Company

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Appendices

Figures

1. Introduction

1.1 What is a Surface Water Management Plan?

1.1.1 A Surface Water Management Plan (SWMP) 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, ordinary watercourses and ditches that occurs as a result of heavy rainfall.

1.1.2 This SWMP study has been undertaken as part of the Drain London Project1 in consultation with key local partners who are responsible for surface water management and drainage in the London area. These include the Greater London Authority, Thames Water, the Environment Agency and Transport for London. The Partners have worked together to understand the causes and effects of surface water flooding so that they can agree the most cost effective way of managing surface water flood risk for the long term.

1.1.3 This document also establishes a starting point for a long-term action plan to manage surface water and will influence future capital investment, maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

1.2 Background

1.2.1 In May 2007 the Mayor of London consulted on a draft Regional Flood Risk Appraisal (RFRA). One of the key conclusions was that the threat of surface water flooding in London was poorly understood. This was primarily because there were relatively few records of surface water flooding and those that did exist were neither comprehensive nor consistent. Furthermore the responsibility for managing flood risk is split between Boroughs and other organisations such as Transport for London, London Underground, Network Rail and the Environment Agency and Thames Water. Relationships between surface water flooding and other sources of flood risk were also found to be unclear. To give the issue even greater urgency it is widely expected that heavy storms will increase in frequency with climate change.

1.2.2 The Greater London Authority, London Councils, Environment Agency and Thames Water commissioned a scoping study to test these findings and found that this was an accurate reflection of the situation. The conclusions were brought into sharp focus later in the summer of 2007 when heavy rainfall resulted in extensive surface water flooding in parts of the UK such as Gloucestershire, Sheffield and Hull causing considerable damage and disruption. It was clear that a similar rainfall event in London would have resulted in major disruption. The Pitt Review examined the flooding of 2007 and made a range of recommendations for future flood management, most of these have been enacted through the Flood and Water Management Act 2010 (FWMA).

1.2.3 Defra recognized the importance of addressing surface water flooding in London and fully funded the Drain London project. The Drain London project is delivered through 3 'Tiers' as shown in Figure 1-1 and Table 1-1. This SWMP is part of the Tier 2 package of works.

[1] Further information on the Drain London Project can be found here http://www.london.gov.uk/drain-london

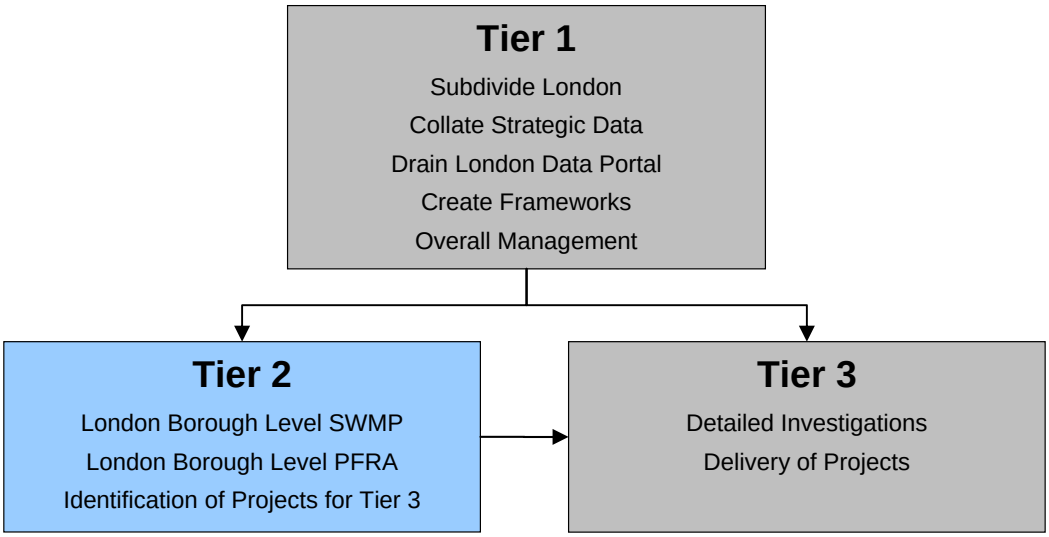


Figure 1-1 Drain London Project 'Tier' Structure

1.2.4 Table 1-1 further describes the activities undertaken in each of the Tiers. The management groups for Tier 2 of the Drain London Project are shown in Figure 1-2; the London Borough of Sutton is within Group 8 of the Drain London management group, and is grouped with the London Borough of Croydon, London Borough of Richmond upon Thames and Royal Borough of Kingston upon Thames.

Table 1-1 Drain London Project 'Tier' Structure

Tier	Summary
Tier 1	a) A high level strategic investigation to group the 33 separate boroughs into a smaller number of more manageable units for further study under Tiers 2 and 3. b) Collection and collation of relevant information across all London Boroughs and strategic stakeholders including the Environment Agency, Thames Water and Transport for London. c) Development of a web based 'Portal' to provide data management, data storage and access to the various data sets and information across the 'Drain London Forum' (DLF) participants and to consultants engaged to deliver Tiers 2 and 3. d) Develop technical framework documents and prioritisation tools to guide delivery of Tiers 2 and 3.
Tier 2	a) Delivery of 33 Borough-level intermediate Surface Water Management Plans (SWMPs) within the management groups to define and map Local Flood Risk Zones, Critical Drainage Areas and flood policy areas and produce an Action Plan for each borough. b) Delivery of 33 Borough-level Preliminary Flood Risk Assessments to comply with the Flood Risk Regulations 2009 requirements for Lead Local Flood Authorities (LLFAs). c) Define a list of prioritised Critical Drainage Areas for potential further study or capital works in Tier 3, using the prioritisation tool developed in Tier 1.
Tier 3	a) Further investigations into high priority Local Flood Risk Zones/Critical Drainage Areas to further develop and prioritise mitigation options. b) Delivery of demonstration projects of surface water flood mitigation solutions identified in Tier 2 SWMPs. c) Funding or co-funding within the London area for green roofs and other types of sustainable urban drainage (SUDS). d) Set up of at least 2 community flood plans in local communities at risk from flooding

1.2.5 As described in Table 1-1, Tier 2 of the Drain London project involves the preparation of SWMPs for each London Borough. Through the subsequent enactment of the Flood Risk Regulations 2009 (FRR2009), Boroughs are also required to produce Preliminary Flood Risk Assessments (PFRA). The Drain London project has therefore been adjusted to deliver both a PFRA and an SWMP for each London Borough. The London Borough of Sutton PFRA was completed in June 2011. These documents will form an evidence base and provide a major step in meeting Borough requirements as set out in the FWMA. Another key aspect of the Act is to ensure that Boroughs work in partnership with other Local Risk Authorities. Drain London assists this by creating sub-regional partnerships as set out in Figure 1-2.

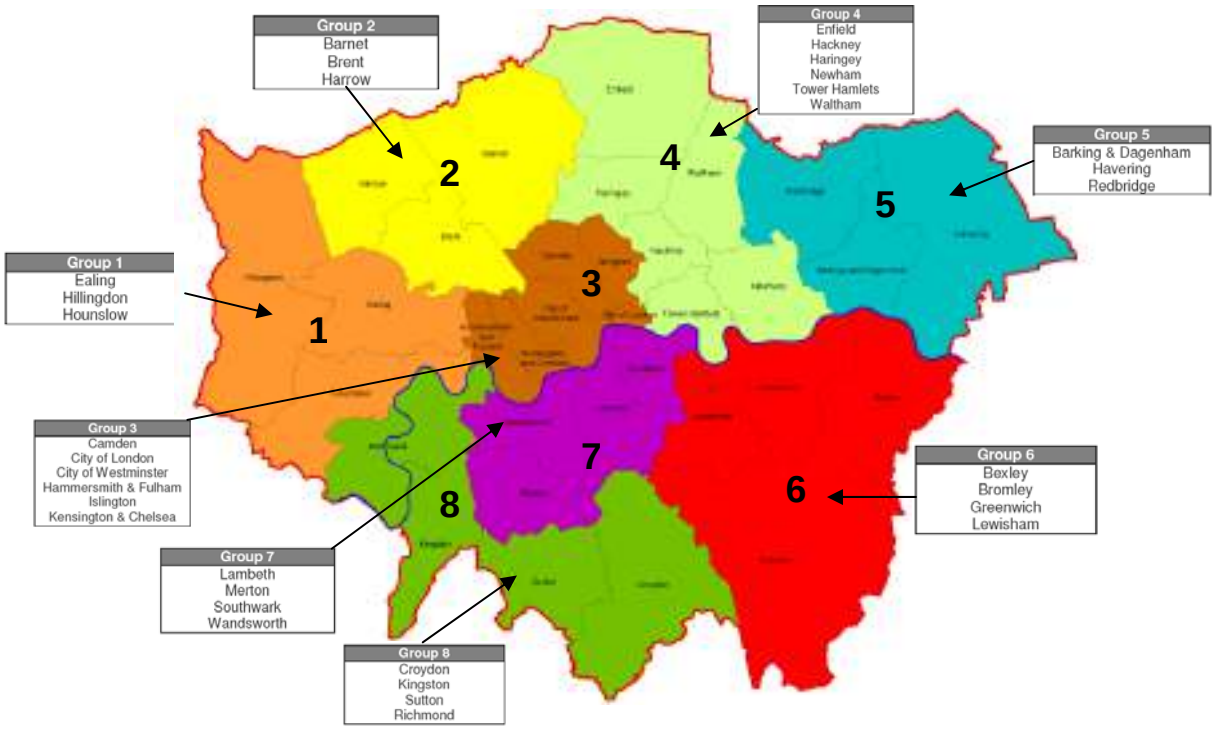


Figure 1-2 Drain London Borough Partnerships

1.3 OBJECTIVES

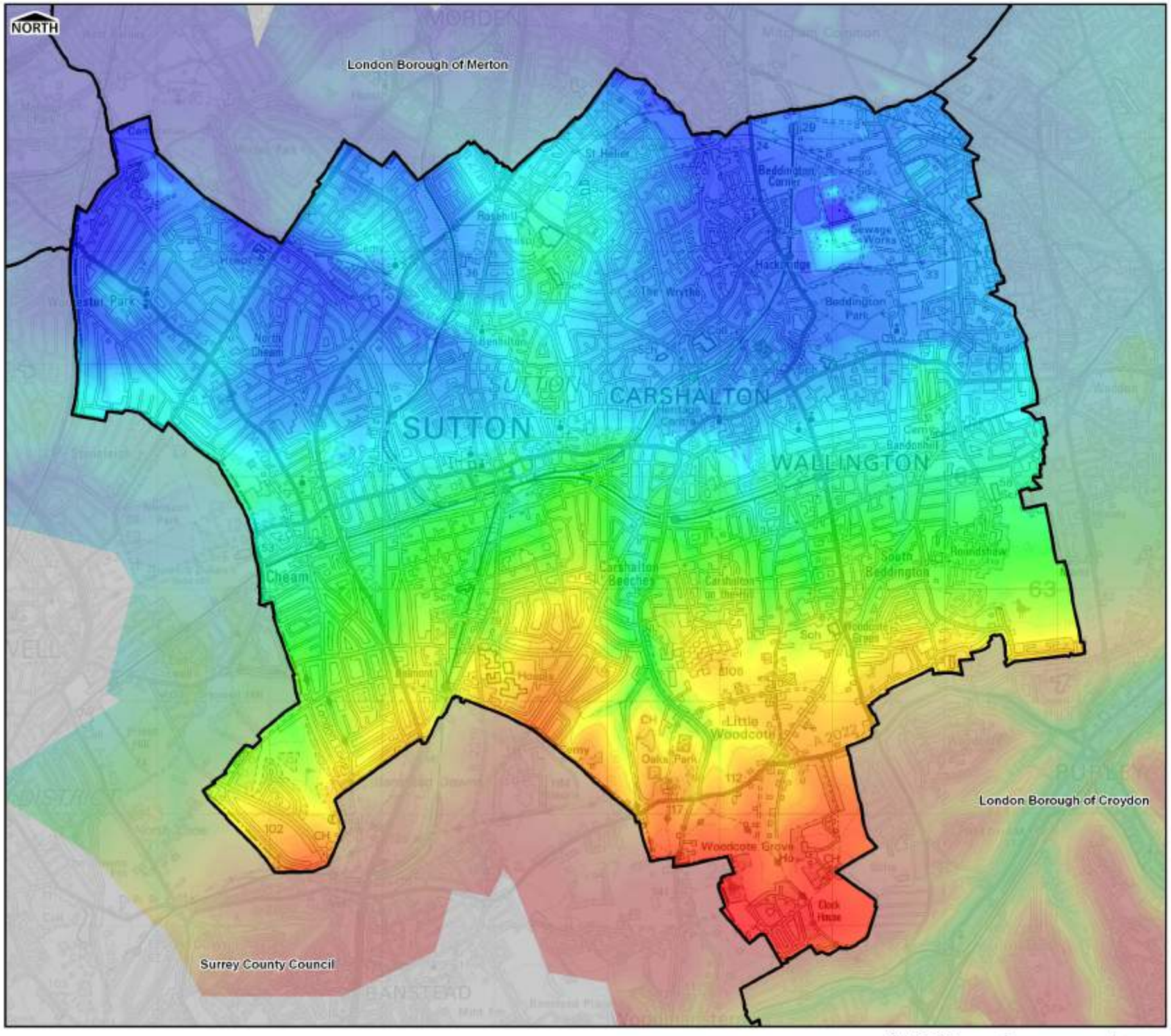
1.3.1 The objectives of the SWMP are to:

- Develop a robust understanding of surface water flood risk in and around the study area, taking into account the challenges of climate change, population and demographic change and increasing urbanisation in London;
- Identify, define and prioritise Critical Drainage Areas (CDAs), including further definition of existing local flood risk zones (LFRZ) and mapping new areas of potential flood risk;
- Make holistic and multifunctional recommendations for surface water management which improve emergency and land use planning, and enable better flood risk and drainage infrastructure investments;

- Establish and consolidate partnerships between key drainage stakeholders to facilitate a collaborative culture of data, skills, resource and learning sharing and exchange, and closer coordination to utilise cross boundary working opportunities;
- Undertake engagement with stakeholders to raise awareness of surface water flooding, identify flood risks and assets, and agree mitigation measures and actions;
- Deliver outputs to enable a real change on the ground rather than just reports and models, whereby partners and stakeholders take ownership of their flood risk and commit to delivery and maintenance of the recommended measures and actions;
- Meet Borough specific objectives as recorded at the outset of the development of the SWMP (further details below);
- Facilitate discussions and report implications relating to wider issues falling outside the remit of this Tier 2 work, but deemed important by partners and stakeholders for effectively fulfilling their responsibilities and delivering future aspects of flood risk management.

1.3.2 Borough specific aims and objectives for the SWMP were discussed at the various meetings held throughout the development of the SWMP. These are summarised below:

- As a priority, establish roles, structures and lines of communication internally within London Borough of Sutton to enable the Council to discharge responsibilities as Lead Local Flood Authority (LLFA);
- Establish links with other LLFAs in Group 8 to draw on collective resources to deliver duties under the FWMA.
- Build upon the Phase 1 and 2 SWMPs prepared for London Borough of Sutton in 2010 to provide hazard mapping across the Borough;
- Identify any potential locations for strategic improvements and upgrades to the existing drainage systems;
- Provide guidance on mitigation options and associated outline costs;
- Provide guidance on London Borough of Sutton's responsibilities and duties as LLFA under the FWMA.



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Legend

- Borough Administrative Boundary
- m AOD
  - 20
  - 45
  - 70
  - 95
  - 120
  - 140

Notes

London Borough of Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:35,000	20/07/2011	D.SKILTON	E.CRAVEN

LiDAR Topographic Survey

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FIGURE 1.4.1

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NORTH

London Borough of Merton

SUTTON

CARSHALTON

WALLINGTON

London Borough of Croydon

Surrey County Council

0 0.25 0.5 1 2 Kilometres

Legend

- Borough Administrative Boundary
- Residential (Derived from EA NRD Dataset)
- Commercial / Industrial (Derived from EA NRD Dataset)
- Open Land & Park Land (Derived from OS Master Mapping)
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Notes

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:35,000	20/07/11	D.SKILTON	E.CRAVEN

Land Use Areas

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SW1P 1PL

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FIGURE 1.4.2

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1.4 STUDY AREA

TOPOGRAPHY & LAND USE

1.4.1 London Borough of Sutton is located in south London and covers an area of approximately 44km^2; it is bounded to the north by London Borough of Merton, to the east by London Borough of Croydon, to the west by the Royal Borough of Kingston and to the south by Surrey County. The Borough is intersected by railway routes that run west to east across the borough. The A232, A24 and A217, Transport for London red routes, traverse the borough from south to north, providing key routes into central London.

1.4.2 The topography is characterised by steep slopes in the south of the Borough which then level off to flatter land in the north as shown in Figure 1.4.1. The western part of the Borough feeds the tributaries of the Beverley Brook which then flows into the Royal Borough of Kingston. The River Wandle flows into Sutton from London Borough of Croydon and passes through Beddington and Hackbridge before flowing into London Borough of Merton. The central part of the Borough, primarily comprising Carshalton centre, is characterised by high groundwater table and emerging springs which feed into the Carshalton branch of the Wandle.

1.4.3 As shown in Figure 1.4.2, the majority of the Borough is urbanised and contains the district centres of Wallington, Carshalton, Rosehill, Worcester Park, North Cheam, and Cheam together with Sutton Town Centre, one of 4 Metropolitan Centres within South London. However, 616 hectares (ha) of the Borough's open space is designated as Metropolitan Green Belt, consisting of Little Woodcote and Cuddington to the south of the Borough. In addition there are 530 ha of Metropolitan Open Land (MOL) on 21 sites and 518 ha of public open space on 244 sites distributed throughout the remainder of the Borough.

Figure 1.4.1 – LiDAR Topographic Survey
Figure 1.4.2 – Land Use Areas

HISTORIC FLOODING

1.4.4 According to national research undertaken by Defra[2], Sutton is ranked the 30th settlement in England most susceptible to surface water flooding, with as many as 9,900 properties estimated to be at risk.

1.4.5 The Strategic Flood Risk Assessment for London Borough of Sutton[3] identifies significant surface water flooding from the summer 2007 flood event when intense rainfall exceeded the capacity of the existing highways drainage systems, and led to substantial overland flow and ponding of surface water in low lying areas. Drainage systems were overwhelmed in several locations across the Borough in 2007, 2008, 2009 and 2010 most notably in Beddington, Hackbridge, Worcester Park and Wallington.

1.4.6 Furthermore, as part of the Borough's Flood Plan, as many as 26 discrete locations have been identified within the Borough as at risk of flooding due to gullies easily becoming blocked or a lack of capacity during intense rainfall events.

[2] National Rank Order of Settlements Susceptible to Surface Water Flooding, Defra 2009
[3] Scott Wilson Group (2009) Strategic Flood Risk Assessment for London Boroughs of Wandsworth, Merton, Sutton and Croydon

1.4.7 Media and meteorological research carried out as part of the Local Climate Impact Profile (LCIP) for London Borough of Sutton4 identified 35 reports of heavy rain and flooding in the Borough between January 1998 and December 2008. The two most significant events were on 15th September 2000 (58mm rain) and 20th July 2007 (over 40mm rain). During the July 2007 event, the volume of rainfall exceeded the design capacity of the urban drainage system and urban watercourses and caused widespread damage to more than 1,200 properties and extensive disruption to transport systems5 . Residents were displaced from their homes and boil notices were issued when the risk of water contamination was identified.

1.4.8 Under UKCP09, predictions for future rainfall for the Sutton area up to 2050 are for up to 14% more winter precipitation under the 'medium emission' scenario. Heavier winter precipitation is expected to become more frequent with 0.25-0.75 more days of 'intense' rainfall (i.e. over 20mm). The risk of exceedance of the urban drainage system and surface water flooding in the Borough is therefore likely to increase into the future unless steps are taken to manage and mitigate this form of flooding.

CROSS BOUNDARY INTERACTIONS WITH NEIGHBOURING LOCAL AUTHORITIES

1.4.9 As shown in Figure 1-2, London Borough of Sutton shares boundaries with LLFAs in Group 7 and Group 8 as well as Surrey County Council which lies outside of the Greater London Authority study area. A summary of the cross-boundary interactions with these LLFAs is provided below.

Interactions with London Borough of Croydon (Group 8)

1.4.10 The boundary between London Boroughs of Sutton and Croydon largely follows the topographical highpoint and there are few significant cross boundary flows with the exception of the path of the River Wandle, a designated Environment Agency Main River. This fluvial watercourse is culverted throughout London Borough of Croydon, coming out of culvert briefly at Wandle Park before passing west into London Borough of Sutton.

1.4.11 Ongoing work relating to the maintenance and management of this watercourse will be led by the Environment Agency and will require cooperation and joint working from both Boroughs.

Interactions with Royal Borough of Kingston (Group 8)

1.4.12 The chief interaction between London Borough of Sutton and the Royal Borough of Kingston is the Beverley Brook, an Environment Agency Main River, which passes along the boundary of these two Boroughs and then continues into the Royal Borough of Kingston.

Interactions with London Borough of Merton (Group 7)

1.4.13 Catchments within the London Borough of Sutton drain chiefly into the London Borough of Merton. The mechanisms for this include two Main Rivers, the Pyl Brook in the north west of the Borough, and the River Wandle in the north east. As well as these fluvial flows, a number of overland flow routes have been identified between these Boroughs resulting in localised flooding, such as Glastonbury Road in the Rosehill area. Measures to alleviate flooding in these locations will require collaborative cross-working between these two Boroughs as well as other stakeholders.

[4] EcoLocal (May 2009) Local Climate Impact Profile (LCLIP) for London Borough of Sutton
[5] LB Sutton (September 2007) Report of the Chief Executive – Flooding on Friday 20th July 2007

Interactions with Surrey County Council

1.4.14 London Borough of Sutton adjoins the administrative area of Surrey County Council to the south of the Borough. Flows of surface water have been identified around the edge of the Borough, including overland flow paths feeding into the catchment of the Beverley Brook at the boundary with the Royal Borough of Kingston, and flows off the predominantly rural land south of Belmont. Any source control and attenuation measures to manage the flood risk in these areas will require collaborative working between London Borough of Sutton and Surrey County Council (or the relevant District Council, where responsibilities have been delegated from Surrey County Council).

FUTURE URBANISATION & DEVELOPMENT

1.4.15 London Borough of Sutton's Core Strategy, adopted as part of Sutton's Local Development Framework (LDF) in December 2009, sets out the Council's vision and spatial strategy for the future development of the Borough over the next 10-15 years, including broad locations for development. Sutton Town Centre and Hackbridge, which are identified as 'centres for sustainable growth and regeneration', are expected to accommodate around 40% and 20% of future housing growth respectively over the Plan period. The remaining housing will be targeted mainly towards Wallington (10%), Worcester Park, North Cheam and Rosehill district centres, which are identified as 'centres for intensification', and the rest of the Borough (20%). Redevelopment in these areas will benefit from a good range of facilities and public transport links as well as help to protect the character of high quality residential areas in the suburbs.

1.4.16 The emerging site Development Policies Development Plan Document (DPD), submitted to the Government in June 2011 for purposes of Examination and scheduled for adoption later this year, sets out the Council's proposed site allocations for Sutton Town Centre, Hackbridge and elsewhere, together with a range of development management policies, including on 'Flood Risk' (Policy DM7) and 'Climate Change Adaptation' (Policy DM8).

1.4.17 In addition, an essential part of the Council's vision is the transformation of Hackbridge into the UK's first sustainable suburb in accordance with the principles of 'One Planet Living' and zero carbon. In seeking to prepare a Supplementary Planning Document (SPD) to guide the regeneration of Hackbridge, the Council commissioned the preparation of a Draft Hackbridge Masterplan[6] in January 2009 which put forward outline development briefs for key redevelopment sites within the area and provided an evidence base for substantiating the Council's policy approach for promoting sustainable growth and regeneration within Hackbridge as part of the LDF.

1.4.18 Within the context of the 'localism' agenda and resource issues, the envisaged Hackbridge SPD is now being taken forward with the local community as a Neighbourhood Development Plan.

1.4.19 These plans for urbanisation and redevelopment within London Borough of Sutton present a significant challenge to the existing drainage systems. However, it is also affords a crucial opportunity to address long-standing issues and problems relating to surface water flooding and pressure points on the drainage system through strategic improvements and upgrades to the drainage system.

[6] Tibbalds Planning & Urban Design et al. (January 2009) Hackbridge Sustainable Suburb Final Draft Masterplan

1.4.20 The SWMP for London Borough of Sutton should afford a particular focus on these areas allocated for further development and urbanisation and identify any potential locations for strategic improvements and upgrades to the existing drainage systems.

1.5 Interactions Between Sources of Flooding

1.5.1 In the context of SWMPs, surface water flooding incorporates flooding from sewers, drains, groundwater, and runoff from land, ordinary watercourses (often referred to as ordinary watercourses) and ditches occurring as a result of heavy rainfall. These sources may operate independently or through a more complex interaction of several sources.

1.5.2 An initial overview of the flooding issues in the London Borough of Sutton reveals areas that are affected by multiple sources of flood risk. These include complex interactions between urban watercourses, direct surface water ponding, overland flow paths and the surface water sewer system. One such example is the Hackbridge area which is susceptible to groundwater flooding, fluvial flooding from the River Wandle, surcharge of the surface water drainage system as well as direct surface water flooding from rainfall that contributes to overland flow-paths.

1.5.3 In order for these flooding mechanisms to be adequately assessed, a holistic approach to surface water management is required. The SWMP approach will seek to ensure that all sources and mechanisms of surface water flood risk are assessed and that solutions are considered in a holistic manner so that measures are not adopted that reduce the risk of flooding from one source to the detriment of another.

1.6 Linkages with Other Plans

1.6.1 The increased focus on flood risk over recent years is an important element of adaptation to climate change. It is important that the SWMP is not viewed as an isolated document, but one that connects with other strategic and local plans. Drain London links into a number of regional and local plans which are discussed in more detail below.

Regional Flood Risk Appraisal (RFRA)

4.1.1 This is produced by the Greater London Authority and gives a regional overview of flooding from all sources. The RFRA will be updated in 2012 to reflect the additional information on local sources of flood risk (surface water, groundwater and ordinary watercourses) from Drain London. The London Plan 2011 was produced in July 2011 and includes a number of policies generated by the RFRA which is being prepared alongside the London Plan 2011. A summary of the policies from the London Plan of relevance to London Borough of Sutton with respect to flood and water management is provided in Table 1-2.

Table 1-2 London Plan 2011 – Policies relevant to surface water management

Policy 5.11 Green roofs and development site environs
Planning decisions
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: • Adaptation to climate change (i.e. aiding cooling) • Sustainable urban drainage • Mitigation of climate change (i.e. aiding energy efficiency) • Enhancement of biodiversity • Accessible roof space

- Improvements to appearance and resilience of the building
- Growing food.

LDF preparation

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

Strategic

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.

Planning decisions

B) Development proposals must comply with the flood risk assessment and management requirements set out in PPS25 over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 (TE2100 – see paragraph 5.55) and Catchment Flood Management Plans.

C) Developments which are required to pass the PPS25 Exceptions Test will need to address flood resilient design and emergency planning by demonstrating that:

- The development will remain safe and operational under flood conditions;
- A strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions;
- Key services including electricity, water etc will continue to be provided under flood conditions;
- 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.

LDF preparation

E) In line with PPS25, boroughs should, when preparing LDFs, utilise Strategic Flood Risk Appraisals 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

Planning decisions

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.

LDF preparation

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.

THAMES CATCHMENT FLOOD MANAGEMENT PLAN (CFMP)

1.6.2 The Thames Catchment Flood Management Plan was published in 2008 by the Environment Agency and sets out policies for the sustainable management of flood risk across the whole of the Thames catchment over the long-term (50 to 100 years) taking climate change into account. More detailed flood risk management strategies for individual rivers or sections of river may sit under these such as those described in Table 1-3.

1.6.3 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.

1.6.4 This Plan will be periodically reviewed, approximately five years from when it was published, to ensure that it continues to reflect any changes in the catchment. There are links to Drain London where there are known interactions between surface water and fluvial flooding.

Table 1-3 CFMP Policy Unit

River Wandle Policy Unit
The River Wandle Policy Unit comprises generally urban areas, with some river flood defences. The preferred policy is Policy 4 – accept the risk – but in the long term take action to ensure that risk does not increase from current level.

Beverley Brook Policy Unit
The Beverley Brook Policy Unit comprises highly developed floodplains with little open space and modified river channels. The preferred policy is Policy 4 – accept the risk – but in the long term take action to ensure that risk does not increase from current level.

Key messages for Policy 4 are as follows:

- Redevelopment rates in some areas are very high and offer the opportunity to reduce the risk and the current reliance on flood defences. This includes making the urban environment more resilient and with a layout that offers more options for managing future flood risk and the impacts of climate change.
- Generally the existing river corridors in these areas provide an opportunity to be able to adapt to the impacts of climate change and we are seeking to safeguard them from inappropriate development. We are seeking to maintain existing assets at least until redevelopment takes place.
- Climate change will mean that we need to adapt the existing defences over time. Rather than replacing them like for like, we will be seeking a different combination of flood storage, river defences and floodplain attenuation.
- Some of these areas are susceptible to rapid flooding from thunderstorms. Emergency response and flood awareness are particularly important.

PRELIMINARY FLOOD RISK ASSESSMENT (PFRA)

1.6.5 These are required as part of the FRR2009 which implement the requirements of the European Floods Directive. Drain London has produced a PFRA for each London Borough (LLFA), to give an overview of all local sources of significant flood risk. In London PFRAs will benefit from an increased level of information relating to surface water from the Drain London SWMPs. Boroughs will need to review these PFRAs every 6 years.

SURFACE WATER MANAGEMENT PLANS (SWMP)

1.6.6 Drain London is producing a SWMP for each London Borough. They provide much improved probabilistic 2-dimensional modelling and data on what has been made available at a national scale by the Environment Agency. In addition they contain an Action Plan that has been developed in conjunction with both the Borough and relevant other Risk Management Authorities. This data and actions and associated policy interventions will need to feed directly into the operational level of the Borough across many departments, in particular into spatial and emergency planning policies and designations and into the management of local authority controlled land.

STRATEGIC FLOOD RISK ASSESSMENTS (SFRA)

1.6.7 Each local planning authority is required to produce a SFRA under Planning Policy Statement 25 (PPS25). This provides an important tool to guide planning policies and land use decisions. Current SFRAs have a strong emphasis on flooding from main rivers and the sea and are relatively weak in evaluating flooding from other local sources including surface water, groundwater and ordinary watercourses. The information from Drain London will improve this understanding and the Council may wish to use information within the SWMP to update the Level 1 (Scott Wilson December 2008) and Level 2 (Scott Wilson July 2009) SFRA where necessary.

LOCAL DEVELOPMENT FRAMEWORK (LDF)

1.6.8 Sutton's Local Development Framework (LDF), including the Council's planning policies, site allocations and planning guidelines set out in the adopted Core Planning Strategy DPD (LBS, December 2009), the emerging Site Development Policies DPD, the forthcoming Climate Change SPD and Planning Briefs for specific sites will need to reflect the findings of the SWMP. This may include policies for the whole Borough or for specific parts of Boroughs, for example Critical Drainage Areas. The SWMP will also inform the preparation of the Hackbridge Neighbourhood Development Plan and the preparation of SUDS Adoption Criteria in accordance with the Flood and Water Management Act 2010. There may also be a need to review Planning Briefs and specific site allocations where surface water flood risk is a particular issue. The updated SFRA will assist with this as will the reviewed RFRA and any updated London Plan policies. In producing site-specific Planning Briefs, the GLA and Boroughs will also examine surface water flood risk more closely.

LOCAL FLOOD RISK MANAGEMENT STRATEGIES

1.6.9 The Flood and Water Management Act 2010 (FWMA) requires each LLFA to produce a Local Flood Risk Management Strategy (LFRMS) by December 2012. Whilst Drain London will not actually produce these, the SWMPs, PFRAs and their associated risk maps will provide the necessary evidence base to support the development of LFRMS. No new modelling is anticipated to produce these strategies. Figure 1-3 illustrates how the CFMP, PFRA, SWMP and SFRA link to and underpin the development of a LFRMS.

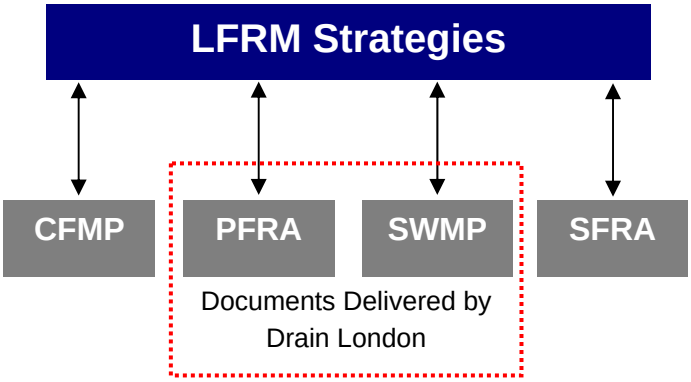


Figure 1-3 Linkages between Flood Risk Management Documents

1.7 EXISTING LEGISLATION

1.7.1 The FWMA presents a number of challenges for policy makers and the flood and coastal risk management authorities identified to co-ordinate and deliver local flood risk management (surface water, groundwater and flooding from ordinary watercourses). 'Upper Tier' local authorities have been empowered to manage local flood risk through new responsibilities for flooding from surface and groundwater.

1.7.2 The FWMA reinforces the need to manage flooding holistically and in a sustainable manner. This has grown from the key principles within Making Space for Water (Defra, 2005) and was further reinforced by the summer 2007 floods and the Pitt Review (Cabinet Office, 2008). It implements several key recommendations of Sir Michael Pitt's Review of the Summer 2007 floods, whilst also protecting water supplies to consumers and protecting community groups from excessive charges for surface water drainage.

1.7.3 The FWMA must also be considered in the context of the EU Floods Directive, which was transposed into law by the FRR2009 on 10 December 2009. The FRR2009 requires three main types of assessment / plan:

1) Preliminary Flood Risk Assessments (PFRAs)
    i. This process involves collecting information on past and future (potential) floods, assembling the information into a PFRA report and spreadsheet, and identifying Flood Risk Areas.
    ii. LLFAs are only required to undertake a PFRA for local sources of flooding, which principally includes surface water, groundwater and ordinary watercourses.
    iii. It is the responsibility of the Environment Agency to assess the flood risk from the following sources; main rivers, the sea and reservoirs
    iv. The PFRA reports and spreadsheets must be completed by 22nd December 2011.
2) Flood Hazard Maps and Flood Risk Maps: Following the identification of Flood Risk Areas, the Environment Agency and LLFAs are required to produce Hazard and Risk maps by 22nd December 2013. The precise requirements of this mapping are still to be confirmed.
3) Flood Risk Management Plans. The Environment Agency and LLFAs are required to produce Flood Risk Management Plans by 22nd December 2015. It is likely that the

SWMP will contribute significantly to the preparation of a Flood Risk Management Plan by London Borough of Sutton.

1.7.4 Figure 1-4 illustrates how this SWMP fits into the delivery of local flood and coastal risk management, and where the responsibilities for this lie.

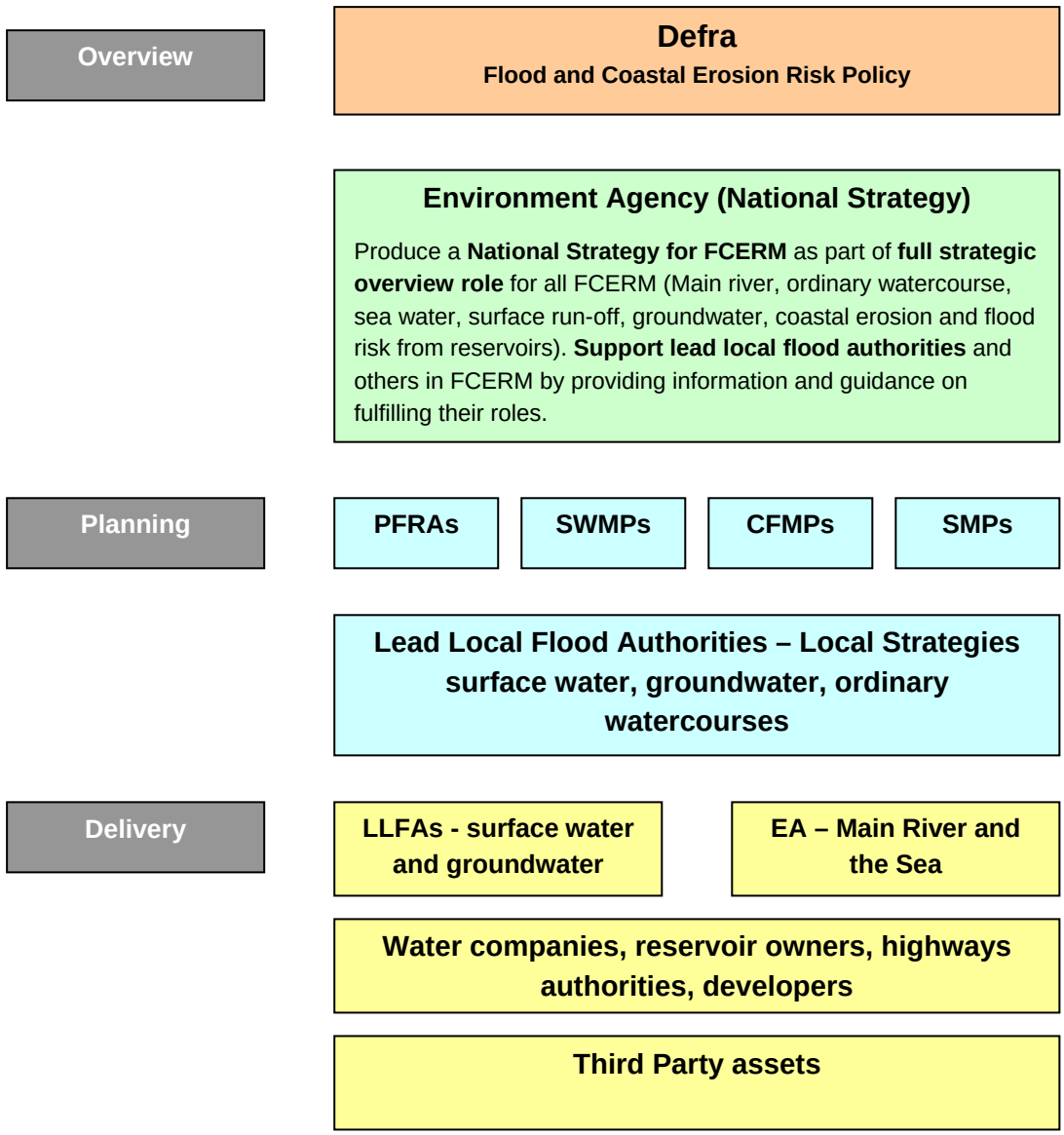


Figure 1-4 Local Flood & Coastal Management: Reports & Responsibilities

1.7.5 Aside from forming partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for LLFAs from the FWMA, and the FRR2009. The preparation of the SWMP and PFRA for London Borough of Sutton as part of the Drain London Project will enable the Council to strengthen its understanding of these responsibilities and how they can be fulfilled by the Borough. These responsibilities include:

- **Investigating flood incidents** – LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying

which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.

- **Asset Register** – LLFAs also have a duty to maintain a register of structures or features which are considered to have a significant effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
- **SuDS Approving Body** – LLFAs are designated the Sustainable Drain age Systems (SuDS) Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new SuDS within their area. This responsibility is anticipated to commence from April 2012.
- **Local Flood Risk Management (LFRM) strategies** – LLFAs are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area. The LFRM strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.
- **Works powers** – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the LFRM strategy for the area.
- **Designation powers** – LLFAs, as well as District Councils and the Environment Agency have powers to designate structures and features that affect flooding in order to safeguard assets that are relied upon for flood risk management. Once a feature is designated, the owner must seek consent from the authority to alter, remove or replace it.

1.8 PEER REVIEW

1.8.1 It is essential for the Drain London Project that SWMPs are consistent and comparable across Greater London. This is to facilitate

- Fair, transparent and rapid allocation of funds to identified high priority flood risk areas within London;
- Collaborative working practices between stakeholders; and
- Building of local capability (Council officers and consultants doing work in the future will be able to make use of outputs regardless of who produced them for each Borough).

1.8.2 To ensure consistency and comparability between London Borough SWMPs produced, a Peer Review process has been used. The process involved the four consultant teams working on the Drain London SWMPs independently reviewing each other's work. This has ensured that all outputs result from a consistent technical approach, are of a high technical quality and are communicated in the specified formats. The peer review report for this SWMP is included in Appendix F.

2. Phase 1: Preparation

2.1 PARTNERSHIP

2.1.1 Under the FWMA and the FRR2009, all Unitary Authorities including the London Borough of Sutton are designated 'Local Lead Flood Authority' (LLFA). As such, the London Borough of Sutton is responsible for leading local flood risk management, including establishing effective partnerships within their local authority as well as with external stakeholders such as the Environment Agency, Thames Water Utilities Ltd, Transport for London, Network Rail and London Underground as well as others.

2.1.2 In areas of multiple sources of flood risk and complicated interactions between different sources of flooding, there are often multiple water or drainage regulators, owners and maintainers. It is essential that all relevant partners with responsibility for making decisions and taking actions are involved in plans for flood risk management from the outset. One of the aims of the SWMP for London Borough of Sutton is to strengthen the partnership between these organisations and ensure inclusivity through all phases of this study and future flood risk management in the Borough.

LONDON BOROUGH OF SUTTON FLOOD GROUP

2.1.3 London Borough of Sutton leads discussion on flood risk management for the Borough through the Sutton Flood Group. This comprises representatives from stakeholders identified above as well as multi-departmental representation from within the Borough including environmental sustainability, strategic planning, emergency planning, parks and open spaces and highways drainage teams. The Flood Group was set up following the summer floods of July 2007 with the aim of ensuring collaborative working across relevant stakeholders as described above.

2.1.4 Figure 2-1 provides an illustration of the Sutton Flood Group structure.

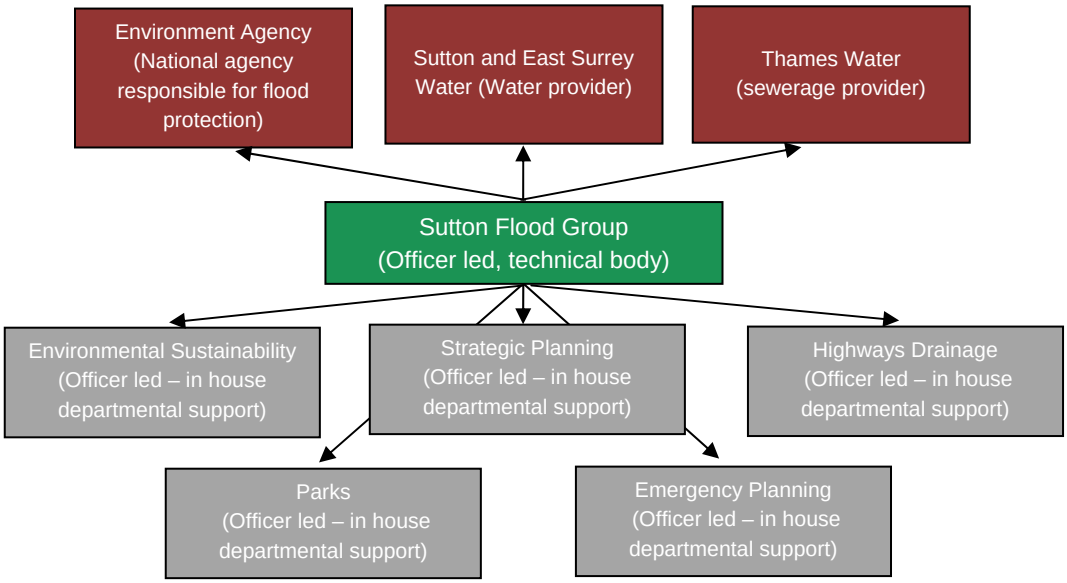


Figure 2-1 London Borough of Sutton Flood Group Structure

2.1.5 The Flood Group can be divided into a Strategic Management Group which is responsible for making overall decisions about flood risk management such as severe weather incident management, operational maintenance, future flood risk investments and planning; and the Operational Management Group which serves as the 'day-to-day' flood risk group delivering the flood risk system operations and maintenance on the ground.

2.1.6 A summary of these roles and responsibilities is shown in Table 2-1.

Table 2-1 Flood Group Members and Roles

Tier 1 - Strategic Management Group		
Organisation	**Name**	**Role**
LB of Sutton	Mark Dalzell	Joint Overall lead on local flood risk management activities within the Council.
LB of Sutton	Patrick Whitter	Joint overall lead on local flood risk management activities within the Council.
LB of Sutton	Gerry McLaughlin	Joint overall lead on local flood risk management activities within the Council.
Thames Water	Mark Dickinson / David Harding	Share data on the performance of Thames Water assets within the administrative area of Sutton. For full SWMP, share sewer model so that an assessment of all sources of risk can be undertaken.
Environment Agency	Tom Sampson / Berhe Kesete	Overview role for Inland Flooding, provide guidance on methodology, share best practice and provide data.
Sutton and East Surrey Water	Peter Isherwood	Share data on performance of Sutton and East Surrey Water assets and local flood risk management issues in the Borough.
URS Scott Wilson	Emily Craven	Technical support and delivery of SWMP.
Tier 2 - Technical & Operational Management Group		
Organisation	**Name**	**Role**
LB of Sutton	Gerry McLaughlin	Operational support. Operational maintenance
LB of Sutton	Ian Kershaw	Linking SWMP and SFRA with Multi-Agency Flood Plan / Severe Weather Plan
Thames Water	Mark Dickinson	Operational manager
Environment Agency	Sarah Bowbrick	Operations and maintenance of EA main rivers - the Pyl Brook, Beverley Brook, and Wandle

SOUTH WEST LONDON STRATEGIC FLOOD GROUP

2.1.7 As part of the Drain London Project, London Borough of Sutton have been working closely with neighbouring Boroughs to forge partnerships with respect to local flood risk management as part of the preparation of SWMPs for all 33 London Boroughs.

2.1.8 As part of this work, suggestions have been put forward for a South West London Strategic Flood Group that would report to the Regional Flood Defence Committee through Councillor Osborne at Royal Borough of Kingston. A potential structure may look something like that shown in Figure 2-2.

2.1.9 Responsibility for flood risk management at Sutton is shared across several departments; at the present time, the overall lead on local flood risk management activities within the Council is undertaken jointly by Mark Dalzell, Gerry McLaughlin and Patrick Whitter.

Figure 2-2 Organogram of Potential South West London Flood Partnership

PUBLIC ENGAGEMENT

2.1.10 Members of the public may also have valuable information to contribute to the SWMP and to an improved understanding and management of local flood risk within the study area. Public engagement can afford significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

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

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

Recommendation 1: Continue to establish partnerships and governance arrangements for the London Borough of Sutton to take forward local flood risk management actions.
Recommendation 2: Formalise governance structure and terms of reference for South West London Strategic Flood Group.
Recommendation 3: Ensure required skills and resources are in place within (or between) LLFA(s) to deliver FWMA and Local Flood Risk Management requirements.
Recommendation 4: Actively engage with members of the public regarding local flood risk management and formulation of the LFRM Strategy.

2.2 DATA COLLECTION

2.2.1 The collection and collation of strategic level data was undertaken as part of the Tier 1 work and disseminated to Tier 2 consultants by the GLA. Data was collected from each of the following organisations:

- London Borough of Sutton
- Highways Agency

- British Airports Authority
- British Geological Survey
- British Waterways
- Environment Agency
- Greater London Authority
- London Underground
- Network Rail
- Thames Water
- Transport for London

2.2.2 A comprehensive data set was passed onto Tier 2 consultants and in some cases additional supplemental data was provided by individual organisations.

2.3 Data Review

2.3.1 Table 2-2 provides a brief summary of key datasets used in the preparation of the SWMP. Further details regarding the datasets used within this SWMP are included in Appendix A.

Table 2-2 Data Review

Data Supplier	Dataset	Description
London Borough of Sutton	Strategic Flood Risk Assessment (SFRA)	The London Borough of Sutton Level 1 and Level 2 SFRA contain useful information on historic flooding, including local sources of flooding from surface water and groundwater.
	Historical flooding records	Historical records of flooding from surface water, groundwater and ordinary watercourses.
	Anecdotal information relating to local flood history and flood risk areas	Anecdotal information from authority members regarding areas known to be susceptible to flooding from excessive surface water, groundwater or flooding from ordinary watercourses.
	Local Climate Impacts Profile (LCLIP) for London Borough of Sutton	The LCLIP Report prepared by EcoLocal identifies weather-related impacts and their associated consequences on infrastructure and services across the London Borough of Sutton.
	Maintenance Regime	Details of the maintenance regimes undertaken by London Borough of Sutton Council.
	Site Visit Notes	Details of site visits undertaken with Gerry McLaughlin, London Borough of Sutton.
	Phase 1 & 2 Surface Water Management Plan	Former SWMP prepared for London Borough of Sutton.
Environment Agency	Environment Agency Flood Map (Fluvial)	Shows the extent of flooding from rivers with a catchment of more than 3km^2 and from the sea.
	Areas Susceptible to Surface Water Flooding	A national outline of surface water flooding held by the Environment Agency and developed in response to Pitt recommendations. Available on EA Geostore.
	Flood Map for Surface Water	A second generation of surface water flood mapping which was released at the end of 2010. Available on EA Geostore.
	National Receptors Dataset (v1.0)	A nationally consistent dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure

Data Supplier	Dataset	Description
		and electricity substations. Available on EA Geostore.
	Indicative Flood Risk Areas	National mapping highlighting key flood risk areas, based on the definition of 'significant' flood risk agreed with the Defra. Included within LB Sutton's PFRA (Annex 5).
	Historic Flood Map	Attributed spatial flood extent data for flooding from all sources.
	Groundwater Flooding Database	Database of groundwater flooding incidents recorded in the last 10 years.
	Thames Estuary 2100 (TE2100) Groundwater Hazard Maps	Environment Agency / Jacobs dataset of the Thames Estuary 2100 (TE2100) Groundwater Hazard Maps
Thames Water Utilities Limited	DG5 Register for Thames Water Utilities areas	DG5 Register logs and records of properties at risk of flooding from sewers. The dataset supplied provides those properties at risk at end of June 2010.
	Thames Water Sewer Network and Asset Location	The Thames Water Sewer network shows the location and size of the foul, combined, surface water and storm relief sewers across the Greater London area along with the locations for Sewage Treatment Works, Pumping Stations and Combined Sewer Overflows.
Greater London Authority	Ordnance Survey Mapping (1:10k, 1:50k, Mastermap)	Ordnance Survey Mapping for the Greater London Area for the 1:10k and 1:50k scale and Mastermap dataset.
London Fire Brigade	Historical flooding call-out records	Records of all London Fire Brigade callouts for 'flooding' events since 2000. However, no flooding source is provided, so could be a result of water mains bursting as well as heavy rainfall / surface water flooding.
Network Rail	Areas Prone To Flooding	A list of areas prone to flooding across their South East Territory.
Transport for London (TfL)	TfL Red Routes	Pdf of the TfL Red Routes for the Greater London area
	TfL Gullies	GIS dataset of the TfL owned / managed gullies along the Red Routes for the Greater London area
	TfL Pumps	Location and pump regimes for TfL owned / managed gullies in the Greater London area
British Geological Survey	Groundwater Flooding Susceptibility Map	GIS dataset of areas susceptible to groundwater flooding
Jacobs / JBA	Groundwater Emergence Maps (GEMs)	GIS dataset of areas of groundwater emergence (GEMs)
	Groundwater Flood Map	GIS dataset of groundwater flood map
	Increased Potential for Elevated Groundwater (iPEG)	GIS dataset of areas of increased potential for elevated groundwater (iPEG), produced using existing Environment Agency, BGS and Jacobs / JBA datasets, produced for the Greater London area for the purpose of assessing groundwater flood risk as part of the Drain London project.

Security, Licensing and Use Restrictions

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

2.3.3 The following national datasets provided by the Environment Agency are available to local authorities and their consultants for emergency planning and strategic planning purposes:

- Flood Map for Rivers and the Sea
- Areas Susceptible to Surface Water Flooding
- Flood Map for Surface Water
- National Receptor Database

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

- Strategic Flood Risk Assessment
- Catchment Flood Management Plan

2.3.5 The use of some of the datasets made available for the SWMP has been restricted and is time limited, licensed to London Borough of Sutton via the Greater London Authority for use under the Drain London Project, which includes the production of a SWMP for the London Borough of Sutton. The restricted datasets include records of property flooding held by the Council and by Thames Water Utilities Ltd, and data licensed by the Environment Agency. Necessary precautions must be taken to ensure that all information given to third parties is treated as confidential. The information must not be used for anything other than the purpose stated in the agreement. No information may be copied, reproduced or reduced to writing, other than what is necessary for the purpose stated in the agreement.

2.4 ASSET REGISTER

2.4.1 Section 21 of the FWMA sets a duty on LLFAs to maintain a register of structures or features, and a record of information about each of those structures or features, which, in the opinion of the authority, are likely to have a significant effect on flood risk in its area. From the 6th of April 2011 all LLFAs have a duty to maintain a register. The legal characteristics of the register and record are outlined in Table 2-3.

Table 2-3 Legal Characteristics of Asset Register & Records

	Register	Record
a	Must be made available for inspection at all reasonable times.	Up to the LLFA to decide if they wish to make it available for inspection
b	Must contain a list of structures or features which in the opinion of the authority, are likely to have a significant effect on a local flood risk.	For each structure or feature listed on the register, the record must contain information about its ownership and state of repair.
C	s.21 (2) of the Act allows for further regulations to be made about the content of the register and record. There is currently no plan to provide such regulations therefore their content should be decided on by the LLFA depending on what information will be useful to them.	
d	There is no legal requirement to have a separate register and record although as indicated above, only the register needs to be made available for public inspection.	

2.4.2 Defra have provided each LLFA with templates to demonstrate what information should be contained in the asset register (e.g., asset type, asset location, asset condition). Although these templates are not intended as a working tool, they provide a good example of how an asset register might be structured.

2.4.3 Populating and ensuring the ongoing maintenance of the asset register is outside the scope of the Drain London project and is the responsibility of each London Borough. The expectation from Defra is that LLFAs will utilise a risk-based approach to populate the register and record with those structures or features considered the most significant first. It is also important to note that the register will be a 'living' asset register and grow over time, as more structures and features are identified and added, and asset information is updated through further information, for example through surveys of the structures, being made available.

2.4.4 Appendix B provides a summary of the current status of the asset register for London Borough of Sutton as well as recommendations for future actions.

Recommendation 5: Establish and populate a standardised Asset Register for London Borough of Sutton, as required under the FWMA 2010.

2.5 PHASE 1 – SUMMARY

2.5.1 Phase 1 of the SWMP has achieved the following:

- Built upon the partnerships established between the Environment Agency, Thames Water, and the London Borough of Sutton through the continued work of the Sutton Flood Group;
- Established a sub-regional flood risk partnership structure for the London Boroughs of Wandsworth, Merton, Croydon, Kingston and Richmond (along with other key stakeholders), through the 'South West London Strategic Flood Group', to take forward and manage flood risk in the future;
- Collected and reviewed flood risk data and knowledge from key stakeholders and partner organisations;
- Set out recommendations for the London Borough of Sutton's Asset Register, as required under the FWMA; and
- Set out the objectives and governance for the Phase 2 – Risk Assessment, Phase 3 – Options Assessment, and Phase 4 – Action Plan of the Sutton SWMP.

3. Phase 2: Risk Assessment

3.1 INTERMEDIATE ASSESSMENT

3.1.1 The aim of the Phase 2 Intermediate Risk Assessment is to identify the sources and mechanisms of surface water flooding across the study area which will be achieved through an intermediate assessment of pluvial flooding, sewer flooding, groundwater flooding and flooding from ordinary watercourses along with the interactions with main rivers. The modelling outputs will then be mapped using GIS software.

3.1.2 SWMPs can function at different geographical scales and therefore necessarily at differing scales of detail. Table 3-1 defines the potential levels of assessment within a SWMP. This SWMP has been prepared at the 'Borough' scale and fulfils the objectives of a second level 'Intermediate Assessment'.

Table 3-1 SWMP Study Levels of Assessment [Defra 2010]

Level of Assessment	Appropriate Scale	Outputs
1. Strategic Assessment	Greater London	Broad understanding of locations that are more vulnerable to surface water flooding. Prioritised list for further assessment. Outline maps to inform spatial and emergency planning.
2. Intermediate Assessment	Borough wide	Identify flood hotspots which might require further analysis through detailed assessment. Identify immediate mitigation measures which can be implemented. Inform spatial and emergency planning.
3. Detailed Assessment	Known flooding hotspots	Detailed assessment of cause and consequences of flooding. Use to understand the mechanisms and test mitigation measures, through modelling of surface and sub-surface drainage systems.

3.1.3 As shown in Table 3-1, the intermediate assessment is applicable across a large town, city or Borough. In the light of extensive and severe historical flooding and the results from the Environment Agency national pluvial modelling suggesting that there are 9,900 properties at risk across the Borough (for a rainfall event with a 1 in 200 probability of occurrence in any given year), it is appropriate to adopt this level of assessment to further quantify the risks.

3.1.4 The purpose of this intermediate assessment will be to further identify those parts of the Borough that are likely to be at greater risk of surface water flooding and require more detailed assessment. The methodology used for this SWMP is summarised below. Further detail of the methodology is provided in Appendix C.

- 2-Dimensional pluvial modelling (using TuFLOW software) has been undertaken following a Direct Rainfall Approach. Rainfall events of known probability are

applied directly to the ground surface and water is routed overland to provide an indication of potential flow path directions and velocities and areas where surface water will pond.

- The 2-Dimensional pluvial modelling has been supported by field visits and visual surveys with the London Borough of Sutton and Environment Agency staff.
- The outputs from the pluvial modelling are verified (where possible) against historic surface water flood records.

3.2 Risk Overview

Surface Water Flood Risk Mapping – Limitations

3.2.1 The mapping shown within this report is intended to identify broad areas which are more likely to be vulnerable to surface water flooding. This allows the London Borough of Sutton and its partners to undertake more detailed analysis in areas which are most vulnerable to surface water flooding.

3.2.2 In addition, the mapping can also be used as an evidence base to support spatial planning to ensure that surface water flooding is appropriately considered when allocating land for development. Furthermore the map can be used to assist emergency planners in preparing their Multi-Agency response plans.

3.2.3 It should be noted that the mapping only shows the predicted likelihood of surface water flooding (this includes flooding from drains, ordinary watercourses and ditches that occurs in heavy rainfall in urban areas) for defined areas. Due to the coarse nature of the source data used, the maps are not detailed enough to define risk for individual addresses. Individual properties therefore may not always face the same chance of flooding as the areas that surround them.

3.2.4 There may also be particular occasions when flooding occurs and the observed pattern of flooding does not in reality match the predicted patterns shown on these maps. The maps reflect all the suitable and relevant data provided and have been produced using expert knowledge to create conclusions that are as reliable as possible. However, it is essential that users of these maps understands the complexity of the data and modelling utilised in their production and are also aware of the associated limitations and uncertainties in the mapping. The maps are not intended to be used in isolation.

3.2.5 The Borough Council and the Drain London Tier 1 and Tier 2 Consultants will not be liable if the maps by their nature are not as accurate as might be desired, or if they are misused or misunderstood despite our warnings. For this reason we are not able to promise that the maps will always be completely accurate or up to date.

Summary of Definitions

Figure 3-1 provides a summary of the terminology used throughout this SWMP; the following sections provide a definition of each area. To avoid confusion and ensure clarity of scale, the hierarchy of definitions is summarised as follows, from smallest to largest:

1. Local Flood Risk Zone (LFRZ, managed at the local scale);
2. Critical Drainage Area (CDA, containing one or more Local Flood Risk Zones – managed at the local scale);

3. Policy Areas (PA, containing one or more Critical Drainage Areas and covering the entire Borough);
4. Flood Risk Area (as defined by the EA / Defra Indicative Flood Risk Areas – an area approximately covering the entire Greater London Area and managed at a strategic scale).

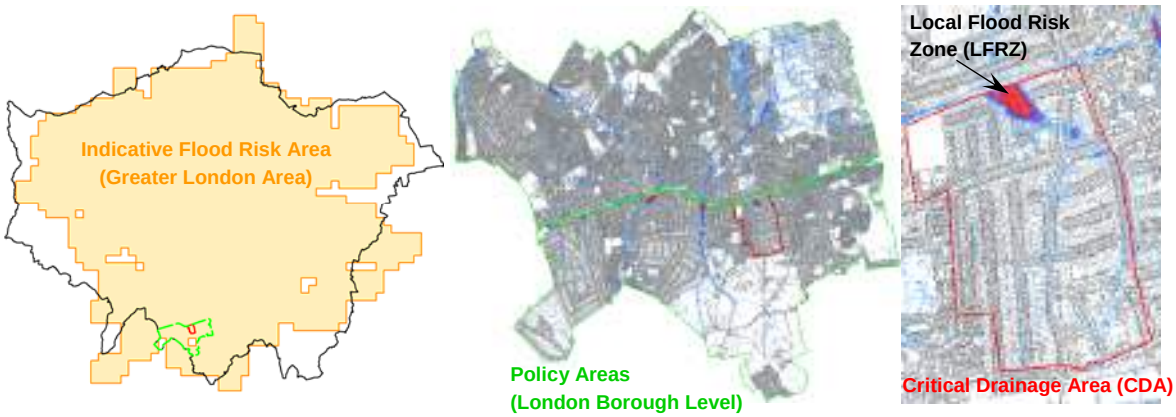


Figure 3-1 Example of Flood Risk Area, Policy Area, CDA and LFRZ

Local Flood Risk Zones

3.2.6 For the purpose of the SWMP, a Local Flood Risk Zone (LFRZ) is defined as:

"A discrete area of flooding that affects houses, businesses or infrastructure".

3.2.7 The LFRZ is defined as the actual spatial extent of predicted flooding in a single location. Related LFRZs can be grouped together as a Critical Drainage Area or left in isolation and considered within the larger Policy Areas.

Critical Drainage Areas

3.2.8 A Critical Drainage Area (CDA) is defined as:

"a discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure."

3.2.9 CDA units are larger than Local Flood Risk Zones and denote an area or catchment where mitigation measures may be implemented to reduce flooding experienced in the flood risk zone. CDA units should be used for site specific detailed planning and capital works schemes and may contain one or more Local Flood Risk Zones.

Policy Areas

3.2.10 A Policy Area is defined as:

'A discrete area within an administrative area where appropriate planning policy can be applied to manage flood risk.'

3.2.11 Policy Areas contain one or more CDAs and cover the entire study area. Policy Areas are primarily based on hydrological catchments but may also accommodate geological concerns and other factors as appropriate. Policy areas may be used to provide guidance on general policy across the study area e.g. the use of soakaways in new development.

Indicative Flood Risk Areas

3.2.12 Indicative Flood Risk Areas are defined by the Environment Agency / Defra definition primarily for the purposes of the preparation of Preliminary Flood Risk Assessments. The Indicative Flood Risk Area covers the entire Greater London Areas and is managed at a strategic scale.

3.3 Surface Water Flooding

Mechanism of Flooding

3.3.1 Surface water or pluvial flooding occurs when high intensity rainfall, often short duration summer storms such as those experienced in London Borough of Sutton in July 2007, generates runoff which flows over the surface of the ground and ponds in low lying areas before entering any watercourse or sewer. It often occurs when the soil is saturated and natural drainage channels or artificial drainage systems have insufficient capacity to cope with the additional flow.

3.3.2 No single organisation has overall responsibility for surface water flooding with different aspects of the drainage system falling to either The Highway Authority (in this case London Borough of Sutton Council), Thames Water, riparian owners and Transport for London (red routes including the A232, A24, and A217).

Pluvial Modelling

3.3.3 The Environment Agency commissioned national scale surface water modelling, resulting in the preparation of the Flood Map for Surface Water (FMfSW 2010) which identified areas at risk of flooding during the 1 in 30 year and 1 in 200 year rainfall events.

Figure D1 – EA Flood Map for Surface Water

3.3.4 In order to continue developing an understanding of the causes and consequences of surface water flooding in the study area, intermediate level hydraulic modelling has been undertaken for a suite of five rainfall event probabilities. This hydraulic modelling has been designed to provide additional information where local knowledge is lacking and forms a basis for future detailed assessments in areas identified as high risk.

3.3.5 A Direct Rainfall approach using Tuflow software has been selected whereby rainfall events of known probability are applied directly to the ground surface and is routed overland to provide an indication of potential flow path directions and velocities and areas where surface water will pond. A full methodology of the hydraulic modelling undertaken is included in Appendix C.

3.3.6 Figures 3.3.1 and 3.3.2 show the modelling results for London Borough of Sutton for the rainfall event with a 1 in 100 annual probability of occurring in any year (1% AEP). Figures for the other modelled return periods are included in Appendix D.

Figure 3.3.1 – Surface Water Flood Depth (1% AEP)
Figure 3.3.2 – Surface Water Flood Hazard (1% AEP)

Figure D6 – Surface Water Flood Depth (1 in 30 annual probability 3.3% AEP)
Figure D7 – Surface Water Flood Hazard (1 in 30 annual probability 3.3% AEP)
Figure D8 – Surface Water Flood Depth (1 in 75 annual probability 1.3% AEP)
Figure D9 – Surface Water Flood Hazard (1 in 75 annual probability 1.3% AEP)
Figure D10 – Surface Water Flood Depth (1% AEP plus climate change)
Figure D11 – Surface Water Flood Hazard (1% AEP plus climate change)
Figure D12 – Surface Water Flood Depth (1 in 200 annual probability 0.5% AEP)
Figure D13 – Surface Water Flood Hazard (1 in 200 annual probability 0.5% AEP)

3.3.7 A summary of the suggested use for each mapped output is provided in Table 3-2.

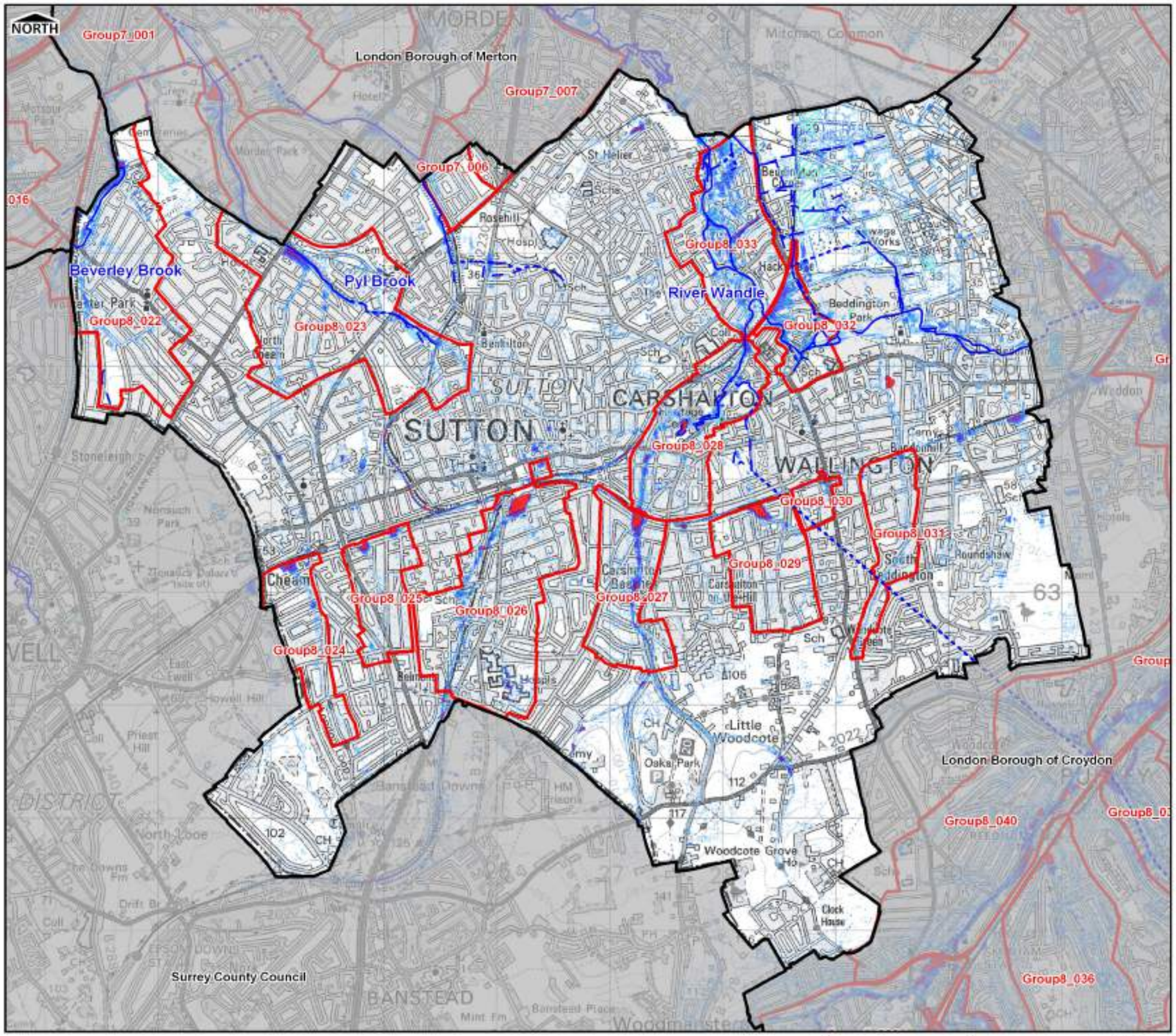
Table 3-2 Modelled Return Periods and Suggested Use

Modelled Return Period	Suggested use
1 in 30 probability of rainfall event occurring in any given year (3.3% AEP)	Current standards require Thames Water sewers to be designed to accommodate rainfall event with a 1 in 30 year return period, however the capacity of existing sewers is likely to be lower. This layer will identify areas that are prone to regular flooding and could be used by highway teams to inform maintenance regimes.
1 in 75 probability of rainfall event occurring in any given year (1.3% AEP)	In areas where the likelihood of flooding is 1 in 75 years or greater insurers will not guarantee to provide cover to property should it be affected by flooding. This GIS layer should be used to inform spatial planning; if property cannot be guaranteed insurance, the development may not be viable.
1 in 100 probability of rainfall event occurring in any given year (1% AEP)	Can be overlaid with Environment Agency Flood Zone 3 GIS layer to show areas at risk under the same event from both sources. Can be used to advise planning teams.
1 in 100 probability of rainfall event occurring in any given year (1% AEP) plus climate change	PPS25 requires that the impact of climate change is fully assessed. Reference should be made to this flood outline by the spatial planning teams to assess the sustainability of developments.
1 in 200 probability of rainfall event occurring in any given year (0.5%AEP)	To be used by emergency planning teams when formulating emergency evacuation plans from areas at risk of flooding.

HISTORICAL SURFACE WATER FLOODING

3.3.8 London Borough of Sutton has provided records of roads and broad locations which experienced flooding during the July 2007 floods[7]. Approximately 120 locations are included in this report. These incidents have been geo-referenced and mapped over the modelling results in Figure D2 (Appendix D).

[7] LB Sutton (September 2007) Report of the Chief Executive – Flooding on Friday 20th July 2007



- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Body
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:35,000	20/07/11	S.LITTLEWOOD	J.ROBINSON

Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

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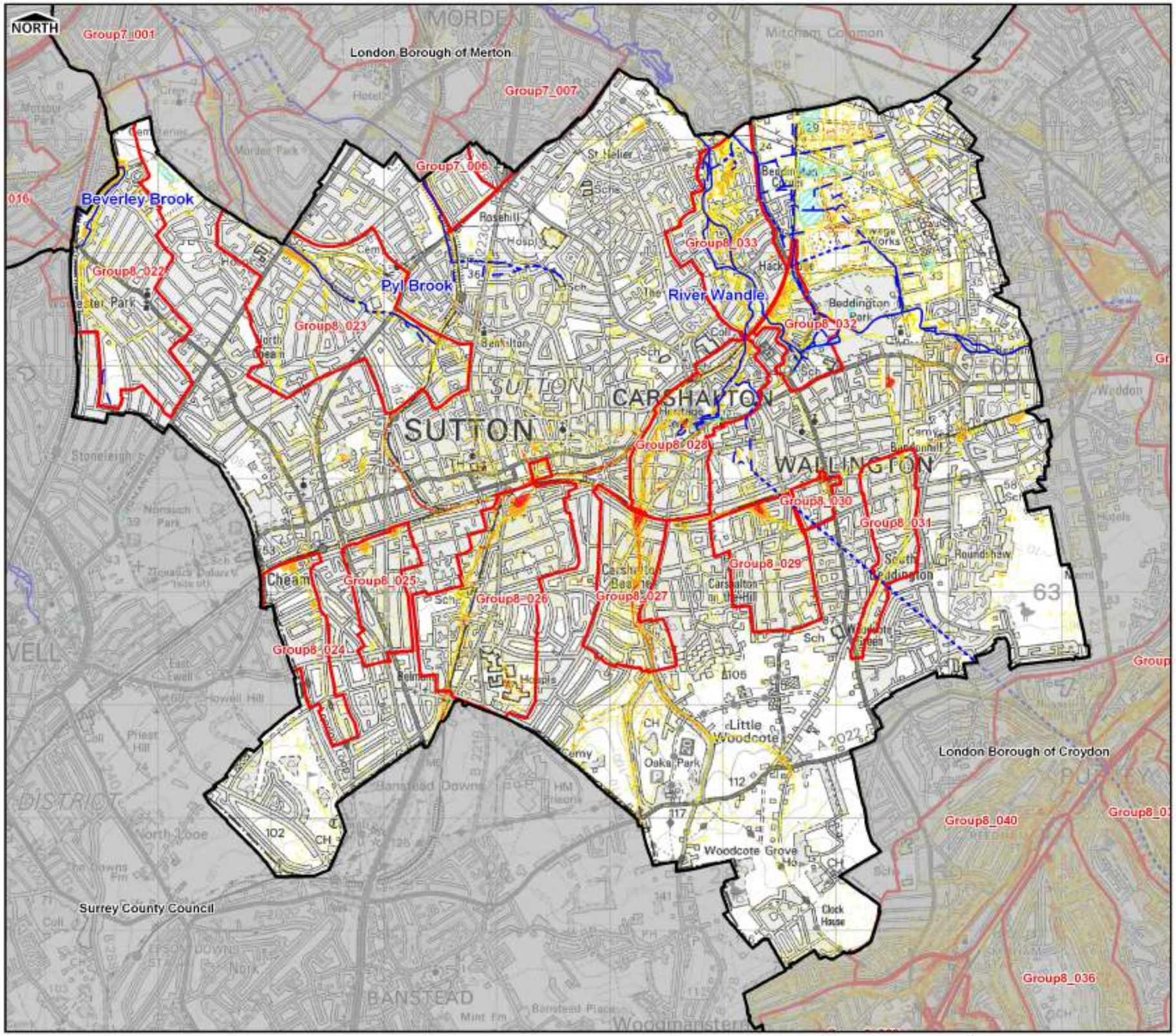
London
SW1P 1PL

Drain London Programme Board Members

Environment Agency · Thames Water · LONDON COUNCILS · GREATERLONDONAUTHORITY

FIGURE 3.3.1



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Body
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:35,000	20/07/11	S.LITTLEWOOD	J.ROBINSON

Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

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FIGURE 3.3.2

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 ID134786I025.GIS

Figure D2 – Surface Water Flood Depth (1% AEP) & Recorded Surface Water Flood Incidents

3.3.9 In addition, a record of the highway drainage improvement works that were undertaken following the July 2007 flooding events has been supplied by London Borough of Sutton. GIS analysis has confirmed that the locations of the drainage improvement works are located in areas identified as being at risk of pluvial flooding based upon the pluvial modelling. (Table 4-5 in Section 4.3 provides a summary of the highway drainage improvements works).

Recommendation 6: Establish and populate a standardised Flood Incident Log to record and investigate future flooding incidents within London Borough of Sutton as required by the FWMA.

3.4 ORDINARY WATERCOURSE FLOODING

MECHANISM OF FLOODING

3.4.1 Ordinary watercourse flooding includes flooding from small open channels and culverted urban watercourses. These small channels often receive most of their flow from inside the urban area and perform an urban drainage function.

3.4.2 London Borough of Sutton have recently undertaken mapping of ordinary watercourses within the Borough. These are shown on Figure 3.4.1 and in Table 3-3.

Table 3-3 Ordinary Watercourses in London Borough of Sutton

Name of Ordinary Watercourse	Location	NGR (Upstream)	NGR (Downstream)	Notes
Lady Margaret's Pool	Pound Street, Carshalton	TQ 2778864435	TQ 2785064506 (culverted TQ 2781064486 to 2785064506)	Fed from spring, and discharges into main river
The Grange Stream	The Grange, Beddington Park	TQ 2892465255	TQ 2879765202	Fed from springs and discharges into main river.
Westcroft Ditch	Grove Park, Carshalton	TQ 2831 864 702	TQ 2806964869 (piped TQ 2814264827 to TQ 2807064870)	Fed from Thames Water sewers discharges into main river.
Mill Green Stream	Mill Green, Mitcham	TQ 2808166737	TQ 2807967038 (culverted TQ 2811566752 to TQ 2808766877)	Fed from main river (Wandle) and discharges into main river (Effluent Carrier).
Grotto Canal	Carshalton Park, Ruskin Road/Talbolt Road and Carshalton Place, Carshalton.	TQ 2825564065	TQ 2820364537	Fed from spring, highway drains and Thames Water sewers, discharges into Thames Water surface water sewer in Carshalton High Street.
Festival Walk	Festival Walk, Carshalton	TQ 2773864479	TQ 2784164530 (culverted TQ 2782864524 to TQ 2784164530)	Fed from springs and Thames water sewers, discharges into main river (Carshalton Ponds)
Lakeside Ponds	Lakeside/London	TQ	TQ 2869965107	Fed from springs and

	Road, Wallington	2862764955	(culverted TQ 2867265030 to TQ 2869265058)	Thames Water sewers, discharges into main river.
Tributary of Beverley Brook	Cuddington Recreation Ground, Worcester Park	TQ 2257564667	TQ 2253864993	Situated fully within LBS park fed from Thames Water surface water sewers, discharges into Thames Water surface water sewer.

Figure 3.4.1 – Ordinary Watercourses

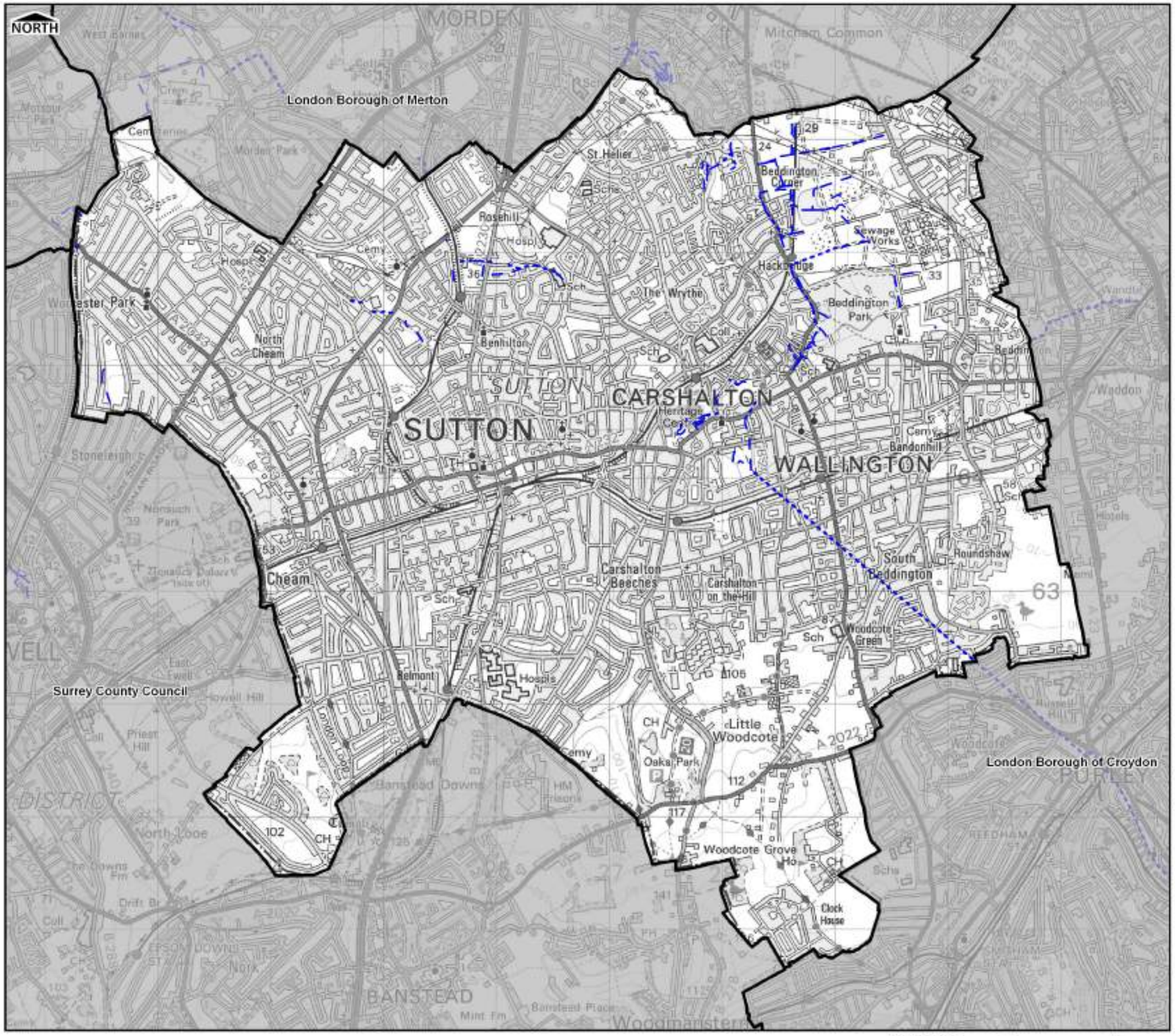
3.4.3 As part of the pluvial modelling, inclusion has been made for an assessment of flooding from ordinary watercourses. The presence of ordinary watercourses has been defined using the DNR dataset provided by the Environment Agency and the ground levels have been determined using the LiDAR topographic data. It is therefore considered that the pluvial flooding maps include an indication of the extent of flooding from ordinary watercourses.

RESPONSIBLE ORGANISATIONS

3.4.4 The responsibility for maintenance of small open channels and culverted urban watercourses which are not designated as 'main river' falls to the London Borough of Sutton and riparian owners who own land on either bank i.e. London Borough of Sutton is only responsible for ordinary watercourses where land on either bank is in Council ownership, or where historical agreements have been made.

3.4.5 Responsibilities as riparian owner are to:

- Pass flow on without obstruction, pollution or diversion affecting the rights of others;
- To accept flows through your land even if caused by inadequate capacity downstream;
- Maintain the bed and banks of the watercourse (including trees and shrubs growing on the banks) and for clearing any debris, natural or otherwise even if it did not originate from your land;
- Watercourses and their banks must not be used for the disposal of any form of garden or other waste;
- Failure in carrying out these responsibilities could result in possible civil action;
- Local Authorities have certain permissive powers to undertake flood defence works and powers for enforcement under the Land Drainage Act 1991 and Public Health Act on watercourses which have not been designated as main rivers.



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Ordinary Watercourse
- Culverted Watercourse

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:35,000	20/07/2011	D.SKILTON	E.CRAVEN

Ordinary and Culverted Watercourses

Consultants
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London
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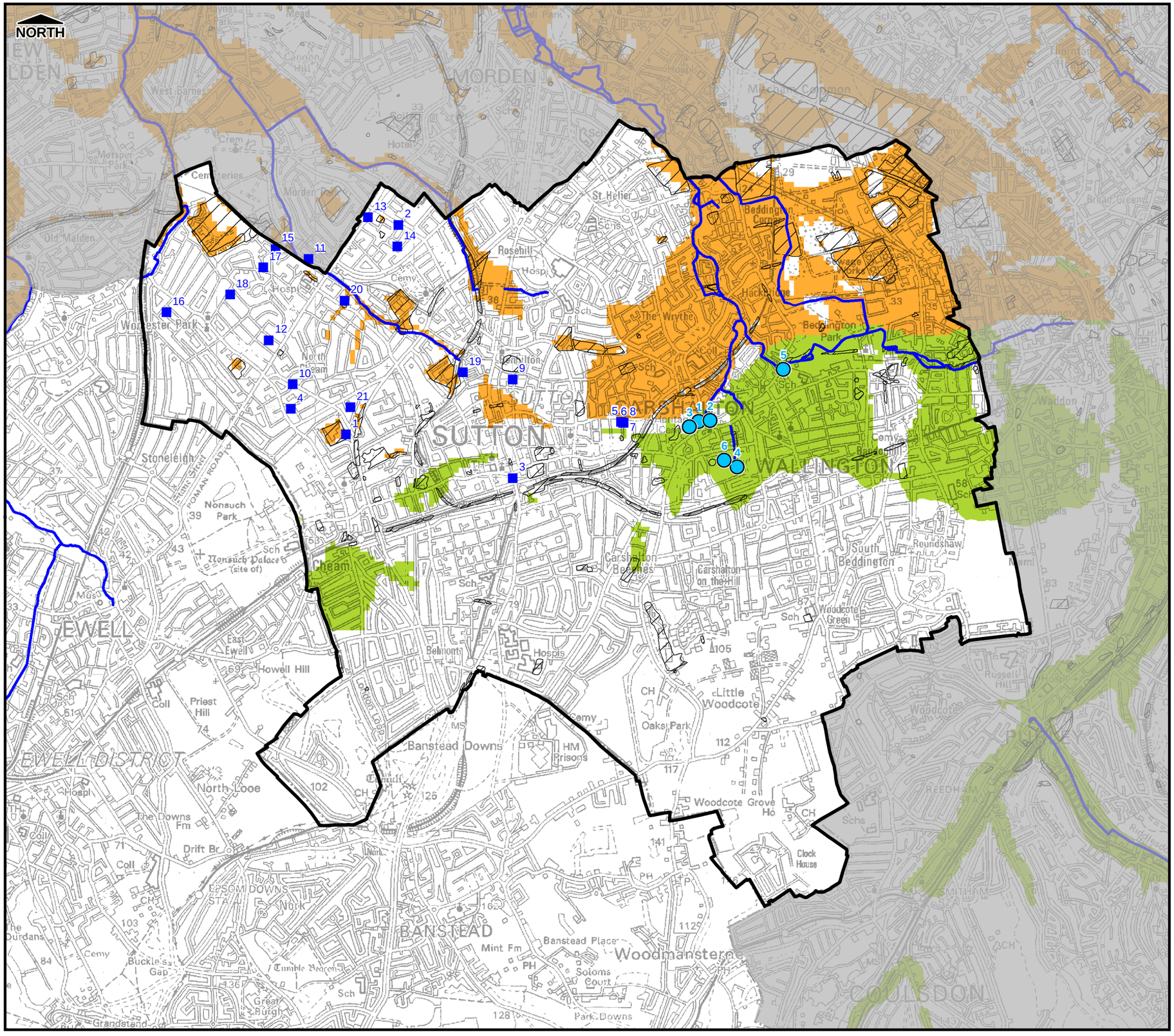
Drain London Programme Board Members

Environment Agency · Thames Water · LONDON COUNCILS · GREATERLONDONAUTHORITY

FIGURE 3.4.1



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Sutton Borough Council
- Sutton EA Flood Incident Data Events
- Spring Location
- Main Rivers
- Artificial (Undivided)

Increased Potential for Elevated Groundwater in

- Permeable Superficial Deposits
- Consolidated Aquifers

Notes

1.The increased Potential for Elevated Groundwater map shows those areas within the London Boroughs where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or be within 2m of the groundsurface. Such groundwater rise could lead to the following:

-Flooding of basements of buildings below ground level;
-Flooding of buried services or other assets below ground level;
-Inundation of farmland, roads, commercial, residental and amenity areas;
-Flooding of ground floors of buildings above ground level; and Overflowing of sewers and drains

2.Incident records shown are generally unconfirmed and may include issues such as water main bursts or non-groundwater related problems.
3.Areas not shown to have increased potential for elevated groundwater should be considered to have a low potential for elevated groundwater - Lack of information does not imply 'no potential' of elevated groundwater in that area.
4.Includes groundwater flood mapping provided by JBA consulting, Copyright. Jeremy Benn Associates Limited 2008-2011, partially derived from data supplied by the Environment Agency.

London Borough of Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:40,000	22/03/2011	C.Woolhouse	S.Cox

Increased Potential For Elevated Groundwater (Drain London Assessment)

Consultants
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Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

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FIGURE 3.5.1

Filepath: D134786 Drain London_Tier 2_Group 8\700 Technical\711 GIS\01 Layout\Sutton\Increased Potential for Elevated Groundwater.mxd

3.5 GROUNDWATER FLOODING

MECHANISM OF FLOODING

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

3.5.2 Groundwater flooding tends to occur sporadically in both location and time, and tends to last longer than fluvial, pluvial or sewer flooding. Basements and tunnels can flood, buried services may be damaged, and storm sewers may become ineffective, exacerbating the risk of surface water flooding. Groundwater flooding can also lead to the inundation of farmland, roads, commercial, residential and amenity areas.

3.5.3 It is also important to consider the impact of groundwater level conditions on other types of flooding e.g. fluvial, pluvial and sewer. High groundwater level conditions may not lead to widespread groundwater flooding. However, they have the potential to exacerbate the risk of pluvial and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer / groundwater interactions.

3.5.4 The need to improve the management of groundwater flood risk in the UK was identified through Defra's Making Space for Water strategy. The review of the July 2007 floods undertaken by Sir Michael Pitt highlighted that at the time no organisation had responsibility for groundwater flooding. The FWMA identified new statutory responsibilities for managing groundwater flood risk, in addition to other sources of flooding and has a significant component which addresses groundwater flooding.

3.5.5 Based on the hydrogeological conceptual understanding of the London Borough of Sutton study area, the potential groundwater flooding mechanisms that may exist are:

- **Chalk catchments in the southern half of LB Sutton:** Groundwater flooding is often associated with Chalk catchments, which allow groundwater levels to rise to the near surface through permeable subsoil following long periods of wet weather and / or reductions in historic abstractions. The London Basin has historically been heavily abstracted, lowering groundwater levels in both the Chalk and the 'Basal Sands'. However, since the '*mid 1960's, declining abstraction has resulted in the water level in the Chalk / Basal Sands aquifer rising at a rate of up to 3 m per year*' (Allen et al., 1997). Therefore, depending on abstraction regimes and the presence and thickness of the London Clay aquiclude, there may be a risk of groundwater flooding.
- **River Terrace Deposits in hydraulic continuity with the River Wandle and its tributaries:** Groundwater flooding can also be associated with substantial River Terrace and Head deposits, where they are in hydraulic continuity with surface watercourses. Stream levels may rise following high rainfall events but still remain "in-bank", and this can trigger a rise in groundwater levels in the associated superficial deposits. The properties at risk from this type of groundwater flooding are probably limited to those with basements, which have been constructed within the superficial deposits.
- **River Terrace Deposits in various locations:** A third mechanism for groundwater flooding is also associated with substantial superficial deposits, but occurs where they

are not hydraulically connected to surface watercourses. Perched groundwater tables can exist within these deposits, developed through a combination of natural rainfall recharge and artificial recharge e.g. leaking water mains.

- **Made ground in various locations:** The forth mechanism for groundwater flooding may occur where the ground has been artificially modified to a significant degree. If this 'made ground' is of substantial thickness and permeability, then a shallow perched water table may exist. This could potentially result in groundwater flooding at properties with basements. However, this should probably be regarded as a local drainage issue as opposed to groundwater flooding. Areas mapped by the BGS as containing made ground are shown in Figures 1 and 2 (in Appendix C).
- **Impermeable (silt and clay) areas down slope of aquifers:** a fifth mechanism for groundwater flooding may occur where groundwater springs / seepages form minor flows and pond over impermeable strata where there is poor drainage (artificial or natural).

EVIDENCE OF GROUNDWATER FLOODING

Figure 3.5.1 – Increased Potential for Elevated Groundwater (iPEG) Dataset & Historic Groundwater Flood Incidents

3.5.6 Figure 3.5.1 shows the locations of a number of groundwater flooding incidents between 2000 and 2010 within the study area that have been reported by the Environment Agency and London Borough of Sutton. Further details are presented in Table 3-4.

3.5.7 It should be noted that there has not been a statutory obligation to record incidences of groundwater flooding in the past. It is therefore likely that this list of groundwater flooding incidents is not exhaustive.

Table 3-4 Available Groundwater Flooding Records

Bedrock Geological Unit*	Overlying Superficial Deposits*	Location	NGR	Incident N°**	Reported Incident	Year
London Clay Formation	None	Cheam	524310 164443	1	Waterlogged garden	2007
London Clay Formation	None	Sutton	524842 166564	2	Drainage/gw flooding	2006
Upper Chalk	None	Sutton	526000 164000	3	Water seeping into basement of shopping centre - southside	2001
London Clay Formation	None	Cheam	523750 164700	4	Waterlogged Garden	2001
Thanet Sand Formation	None	Sutton	527096 164569	5	Water In Cellar Suspected Blockage	2001
Thanet Sand Formation	None	Sutton	527125 164564	6	Water in Cellar, Suspected Blockage	2001
Thanet Sand Formation	None	Sutton	527120 164560	7	Gw Blockage	2001
Thanet Sand Formation	None	Sutton	527120 164560	8	Gw Blockage	2001
London Clay Formation	None	Sutton	526000 165000	9	Blockage of w.t.	2001
London Clay Formation	None	Cheam	523770 164950	10	Occasional flooding in garden	2001
London Clay Formation	None	Morden	523928 166217	11	Swampy garden	2001

London Clay Formation	None	Worcester Park	523528 165396	12	Water coming through walls in October	2001
London Clay Formation	None	North Cheam	524534 166645	13	Damp basement(his neighbour's also)	2001
London Clay Formation	None	Morden	524832 166346	14	Underground stream causing rising damp?	2002
London Clay Formation	None	Worcester Park	523598 166325	15	Water under floorboards	2003
London Clay Formation	None	Worcester Park	522490 165683	16	Damp Kitchen	2003
London Clay Formation	None	Worcester Park	523473 166132	17	Rear garden flooding	2009
London Clay Formation	None	Worcester Park	523137 165858	18	Water in garden	2008
London Clay Formation	Edge of Alluvium	Sutton	525495 165070	19	Water coming up through ground floor	2008
London Clay Formation	Alluvium	Cheam	524295 165799	20	Up to 2 feet of water in garden after heavy rainfall	2009
London Clay Formation	None	Cheam	524355 164717	21	Water in garden for past few weeks.	2009

Note: * Geology of incident based on plotted location (Figures 1, 2 and 8 in Appendix C) & EA record

** Incident reference number as shown on Figures 1, 2 and 8 in Appendix C.

3.5.8 Table 3-4 shows the majority of reported incidents occurred during early 2001; a particularly wet period that resulted in both surface and groundwater flooding incidents in a number of locations across the country.

3.5.9 Each recorded incident has been appraised based on the underlying geology and the potential groundwater flooding mechanisms identified in Section 3.5.1. Incident numbers 1, 2, 4, 9 to 18 and 21 are located over the London Clay Formation and have no known overlying superficial deposits. The London Clay Formation is an aquiclude and does not permit groundwater flow. Based on current available information, it can be suggested that these incidents are probably related to poor drainage over clayey soils following heavy rainfall and are therefore not groundwater flooding incidents.

3.5.10 Flood incident 20 is reported to be underlain by superficial deposits (Alluvium) overlying the London Clay Formation. A perched water table is often present in these superficial deposits, and so it is possible that this is a true groundwater flooding incident. However, it is more likely to be a surface water flooding incident.

3.5.11 Flood incident 19 is underlain by the London Clay Formation, but is within close proximity to superficial deposits (Alluvium and Head deposits). If the permeability of the superficial deposits is high, following heavy rainfall groundwater could emerge at ground surface as springs / seepages and flow to low lying areas over the impermeable London Clay Formation. However, it is likely that surface water runoff following heavy rainfall is the main source of flood waters at this location.

3.5.12 Incident number 3 is located on the Chalk aquifer outcrop and was associated with flooding of a basement. It is likely that this incident is recorded correctly as groundwater flooding, particularly if the basement at this location is particularly deep.

3.5.13 Flood incident numbers 5, 6, 7 and 8 are located on the Thanet Sand Formation outcrop. Incidents 5 and 6 are record as flooding of a basement; it is likely that these incidents are recorded correctly as groundwater flooding. However incidents, 7 and 8 are recorded as

'Groundwater blockage'. Without further information it is difficult to confirm if these are due to groundwater flooding.

POTENTIAL FOR ELEVATED GROUNDWATER

3.5.14 Areas where there is increased potential for groundwater levels to rise within 2 m of ground surface, following periods of higher than average recharge, are shown in Figure 3.5.1. These are separated into permeable superficial deposits and bedrock (consolidated) aquifers. The data set was produced for the whole of the Drain London project area, derived from four individual data sources:

- British Geological Survey (BGS). Groundwater Flood Susceptibility maps;
- Environment Agency (EA). Thames Estuary, 2100 groundwater hazard maps;
- DEFRA. Groundwater emergence maps; and
- JBA. Groundwater flood maps.

3.5.15 It should be noted that for the majority of the Drain London study area, the BGS data set is key, as it includes an assessment of permeable superficial deposits in addition to bedrock (consolidated) aquifers. Owing to the presence of the London Clay Formation aquiclude across the majority of the Drain London study area, the main groundwater flooding mechanisms are associated with perched groundwater tables within permeable superficial deposits.

3.5.16 The Defra and JBA data sets are only available for small areas where the Chalk aquifer is unconfined i.e. where the London Clay Formation is absent. However, the southern half of LB Sutton is one of those areas.

3.5.17 In general, the areas identified by the data as having an increased potential for elevated groundwater are sensible. There is a good correlation with reported spring locations, although the correlation with reported incidents of groundwater flooding is quite poor. However, as identified within Section 3.5.9, it is likely that many of the incidents are not actually groundwater flooding.

3.5.18 Flood incident 3 (basement flooding in the unconfined Chalk) is thought to be a true groundwater flooding incident, although it is not shown as an area with potential for elevated groundwater levels. It is possible that the basement is unusually deep.

3.5.19 Finally, it is important to note that the data set presented in Figure 8 (Appendix C) does not consider groundwater rebound following a reduction of groundwater abstraction. As there are numerous public water supply abstractions in the Borough, they have the potential to influence groundwater levels and therefore groundwater flood risk. A groundwater model would be useful for exploring scenarios where certain abstractions are switched off.

SUTTON SWMP ASSESSMENT (2010)

3.5.20 Prior to the Drain London project, London Borough of Sutton commissioned Scott Wilson to undertake Phase 1 and 2 of its SWMP. As part of Phase 2, Scott Wilson processed and contoured groundwater level data, compared these with ground elevation (LIDAR), and identified areas where there is increased potential for elevated groundwater.

3.5.21 The assessment was largely based on depth to Chalk groundwater table in January 2001, although it also identified permeable superficial deposits where a perched groundwater table

may exist (Appendix C Figure 9).

3.5.22 The areas identified as having Chalk groundwater levels within 2 or 4 m below ground level are fairly similar to those areas identified by the Drain London assessment. One difference is that the Drain London assessment identifies the potential for elevated groundwater levels across a wider area. A second difference is that the earlier 2010 assessment assumes good hydraulic continuity between the Chalk, Thanet Sand Formation and Lambeth Group; the Drain London 2011 assessment assumes that there is limited hydraulic continuity and reduced potential for elevated groundwater levels.

3.5.23 At this stage, there is no information to suggest that one data set is more correct than the other. In addition, neither data set considers the potential for increased groundwater levels following reduced public water supply groundwater abstractions. Therefore, a key recommendation is that a numerical groundwater model is developed / used to improve the assessment of areas with increased potential for elevated groundwater.

SUMMARY OF POTENTIAL FOR ELEVATED GROUNDWATER

Locations where Lambeth Group / Thanet Sand Formation (Basal Sands) outcrop at surface

3.5.24 The Lambeth Group and Thanet Sand Formation are both secondary aquifers and are therefore water bearing. The mapping (Figures 8 and 9, Appendix C) suggests that there is fairly low potential for elevated groundwater levels in these areas. However, it likely that groundwater levels will depend on the degree of hydraulic continuity with the Chalk aquifer and the presence of clay horizons. Site specific investigations should therefore be carried out to confirm the depth to groundwater and monitor seasonal fluctuations before development takes place.

Locations where Upper Chalk outcrops at surface

3.5.25 The Upper Chalk is a principal aquifer and therefore water bearing. The mapping (Figure 3.5.1) suggests there is increased potential for elevated groundwater towards the northern extent of the unconfined Chalk outcrop, particularly in the areas of Carshalton and Wallington.

3.5.26 Groundwater levels in the unconfined Chalk are at significant depth further to the south of the administrative area, with low potential for elevated groundwater. As shown by the cross section in Figure 4 (Appendix C), the depth to groundwater increases towards the north downs.

Locations where London Clay Formation outcrops at surface

3.5.27 The London Clay Formation is an aquiclude and does not permit groundwater flow. In areas where there are no overlying superficial deposits, and the London Clay Formation is of an appreciable thickness, the potential for elevated groundwater is believed to be negligible. It is possible that minor groundwater springs could emerge from nearby aquifer units and then flow onto the London Clay Formation. However, groundwater will not be a key source of flooding in areas underlain this geology.

Locations where London Clay Formation is overlain by superficial deposits

3.5.28 Many of the superficial deposits in the Borough are defined as water bearing and the mapping (Figure 3.5.1) suggests that there is increased potential for elevated groundwater in

these deposits. Of key interest are those areas where the River Terrace Deposits are likely to be in some hydraulic continuity with the River Wandle and its tributaries (The Wrythe, Hackbridge, north of Beddington Park).

3.5.29 There are no continuous groundwater level data to confirm the depth to water within the superficial deposits, or the degree to which groundwater levels fluctuate with river stage. Therefore, site investigations will be important for any proposed development sites in these areas, particularly those considering basements and underground structures such as soakaways.

Recommendation 7: Work with the Environment Agency to record and investigate groundwater flooding incidents and mechanisms.

3.6 SEWER FLOODING

FLOODING MECHANISM

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

1. The rainfall event exceeds the capacity of the sewer system / drainage system

3.6.2 Sewer systems are typically designed and constructed to accommodate rainfall events with a 1 in 30 year return period or less. Therefore, rainfall events with a return period of frequency greater than 1 in 30 years would be expected to result in surcharging of some of the sewer system. While Thames Water is concerned about the frequency of extreme events, it is not economically viable to build sewers that could cope with every extreme.

2. The system becomes blocked by debris or sediment

3.6.3 Over time there is potential that road gullies can become blocked from fallen leaves, build up of sediment and debris (e.g. litter).

3. The system surcharges due to high water levels in receiving watercourses

3.6.4 Within the Borough there is potential for river outlets to become submerged at high tide. When this happens, water is unable to escape into the river and flows back along the sewer. Once storage capacity within the sewer itself is exceeded, the water will overflow into streets and houses. This has been noted to be a particular problem in Hackbridge where combined sewers outfall into the River Wandle.

Figure 3-2 Outfalls to River Wandle, Hackbridge

3.6.5 Within the pluvial modelling methodology, the sewer system has been assumed to have a capacity of 6.5mm/hour. This has been represented by removing 6.5mm/hour from the inflow hyetograph for urban areas, and, in accordance with the specification, no connectivity between the sewer system and the above ground surface has been modelled. More detailed analysis of the interactions through the use of a combined surface water and sewer model could be undertaken in the future if thought beneficial.

RESPONSIBLE ORGANISATIONS

3.6.6 The Highway Authority (London Borough of Sutton and TfL in the case of red routes A24, A217 and A232) are responsible for the effectual drainage of roads in so far as ensuring that drains, including kerbs, road gullies and the pipe network which connects to the trunk sewers are maintained.

3.6.7 Thames Water are responsible for surface water drainage from development via adopted sewers and are responsible for maintaining trunk sewers into which much of Sutton's highway drainage connects.

3.6.8 Riparian owners are responsible for private drainage networks and receiving watercourses where they are small open channels and culverted urban watercourses (see Section 3.4 below).

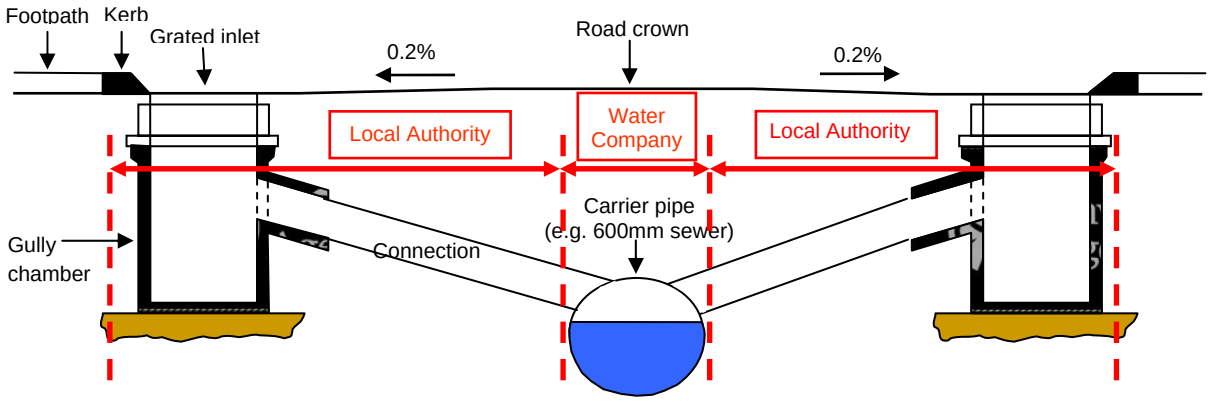


Figure 3-3 Surface Water Drainage Responsibility

3.6.9 In addition to the Thames Water network, there are also some sewers and drains which are in private ownership. Most of these private systems connect to the Thames Water public sewerage system for treatment; however private owners can also connect foul water to septic tanks and storm water to soakaways.

3.6.10 The southern part of the Borough is underlain by chalk and is not served by a Thames Water surface water drainage system. Drainage is provided for the highways by way of soakaways and linked systems of soakaways which are maintained by London Borough of Sutton as the highways authority. Properties are also served by soakaways and it is the responsibility of the property owner to maintain these systems.

THAMES WATER DATASETS

3.6.11 Thames Water has provided their DG5 database which details the total number of sewer flood incidents that have affected properties both externally and internally over the last 10 years. The DG5 dataset is provided on a five-digit postcode area, which makes it difficult to determine more precisely where sewer flooding problems may have occurred. In addition, Thames Water focus their efforts on removing properties from the DG5 register, and therefore this dataset may no longer accurately represent those properties which are currently at risk.

3.6.12 Thames Water has also provided details of their utility infrastructure including sewers, pumping stations and outfalls. This information has been overlaid onto critical drainage areas to inform on potential mitigation options for each location. Thames Water is keen to work with Councils in order to mitigate flood risk issues. Where required in order to further inform detailed design of mitigation options, Thames Water have agreed to make network models available. Figure D4 shows the Thames Water sewer network.

Figure D4 – Thames Water Sewer Network
Figure D5 – Historic Sewer Flooding Incidents

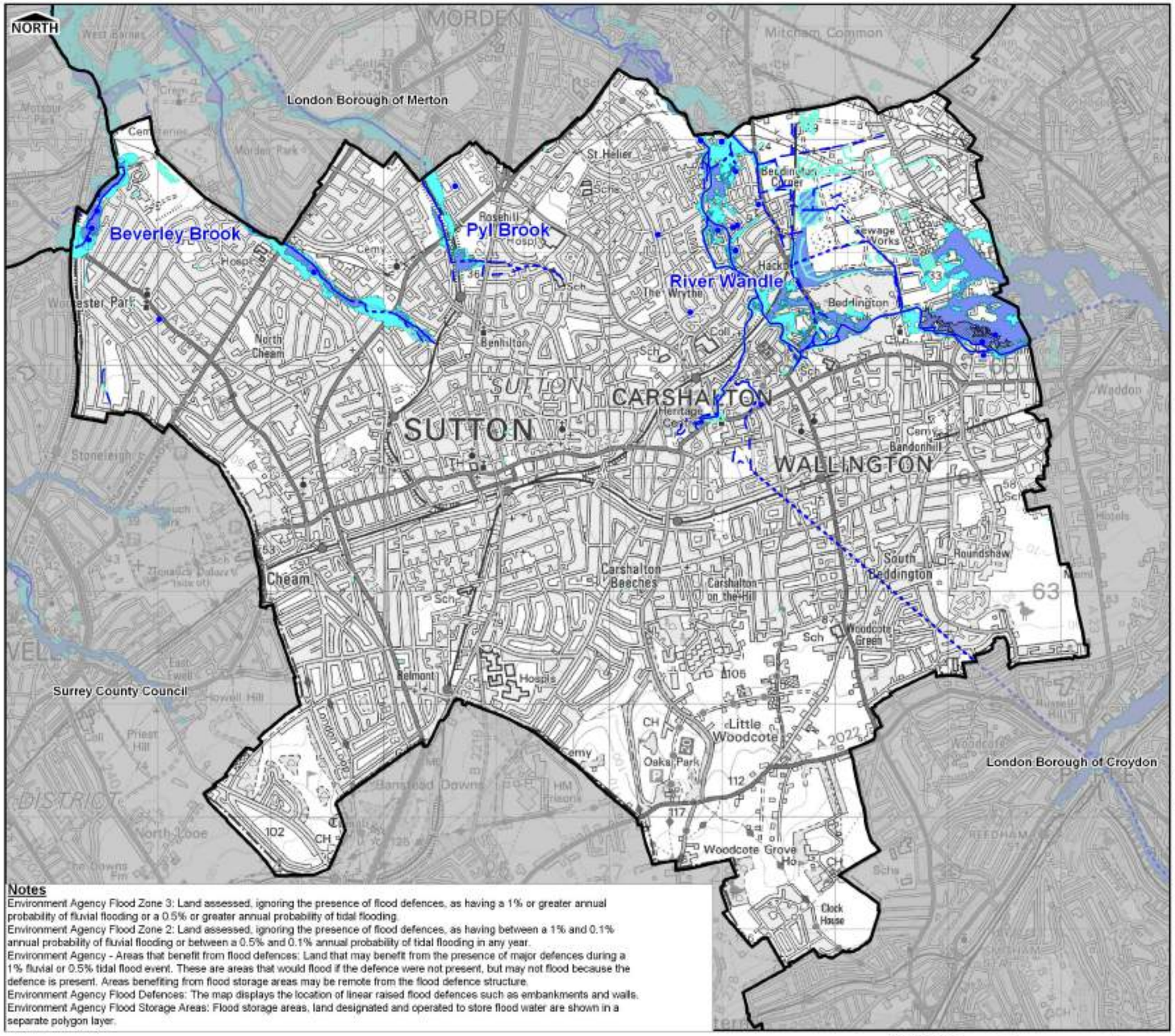
HISTORIC SEWER FLOODING

3.6.13 A review of Figure D5 shows that there are records of sewer flooding in the majority of the Borough. The sewer flooding records highlight the following areas as being at a higher risk of sewer flooding:

- Worcester Park KT4 8 (22 incidents of sewer flooding)
- North Cheam SM3 9 (30 incidents of sewer flooding)
- Rosehill SM1 3 (22 incidents of sewer flooding)
- Northern part of Carshalton SM5 2 (42 incidents of sewer flooding)

3.6.14 London Borough of Sutton is also aware of a number of locations that are susceptible to sewer flooding. Site inspections of the following key sewer flooding sites have been undertaken. Further details are provided in Section 3.8.

- Surcharging of surface water sewer system at Wallington Rail Bridge (Figure 3-4).
- Flooding along Cedar Road partially attributed to the design of the surface water sewers at this location which pass through a 90° bend causing water to surcharge onto the highway.
- 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, 4 outfalls enter the channel of the Beverley Brook, ranging in diameters of 229mm, 930mm, 991mm and 1,830mm. These are large outfalls and 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.



Notes

Environment Agency Flood Zone 3: Land assessed, ignoring the presence of flood defences, as having a 1% or greater annual probability of fluvial flooding or a 0.5% or greater annual probability of tidal flooding.

Environment Agency Flood Zone 2: Land assessed, ignoring the presence of flood defences, as having between a 1% and 0.1% annual probability of fluvial flooding or between a 0.5% and 0.1% annual probability of tidal flooding in any year.

Environment Agency - Areas that benefit from flood defences: Land that may benefit from the presence of major defences during a 1% fluvial or 0.5% tidal flood event. These are areas that would flood if the defence were not present, but may not flood because the defence is present. Areas benefiting from flood storage areas may be remote from the flood defence structure.

Environment Agency Flood Defences: The map displays the location of linear raised flood defences such as embankments and walls.

Environment Agency Flood Storage Areas: Flood storage areas, land designated and operated to store flood water are shown in a separate polygon layer.

Legend

- Borough Administrative Boundary
- Flood Zone 2
- Flood Zone 3
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Permanent Water Bodies
- Areas Benefiting from Flood Defences
- Flood Storage Area
- Defences
- Fluvial Flood Incidents

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:35,000	20/07/2011	D.SKILTON	E.CRAVEN

Environment Agency Flood Map and Fluvial Flood Incidents

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

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FIGURE 3.7.1

Source: www.yourlocalguardian.co.uk

Figure 3-4 Surcharging of surface water system at Wallington Rail Bridge

Recommendation 8: Work with Thames Water Utilities to identify areas where sewer flooding impacts on surface water flooding.

3.7 OTHER INFLUENCES

3.7.1 The Environment Agency has responsibility over flooding from designated Main Rivers and flooding from this source has been further assessed as part of the previously completed Level 1 and 2 Strategic Flood Risk Assessments for the London Borough of Sutton.

Figure 3.7.1 – EA Main Rivers, Flood Zones & Fluvial Flood Incidents
Figure D3 – EA Main Rivers and Flood Zones

3.7.2 The River Wandle flows south to north across the northern administrative boundary of London Borough of Sutton in the area of St Helier (north east area of Sutton Borough). The Wandle has two tributaries; the Carshalton branch, flowing through Carshalton and joining the Wandle in the area of The Wrythe and the eastern branch, flowing from the eastern administrative boundary through Beddington Park before the confluence with the Carshalton branch.

Figure 3-5 River Wandle, Hackbridge

3.7.3 The Pyl brook and Pyl brook eastern branch also flow through the administrative area of

Sutton, flowing south east to north west in the north western area of Sutton Borough, before crossing the administrative boundary into London Borough of Merton. Considerable flooding associated with the Pyl Brook was experienced in July 2007.

3.7.4 Figure D3 in Appendix D shows the Main Rivers and Flood Zones covering the London Borough of Sutton, using the Environment Agency Flood Map.

3.7.5 The effects of Main River flooding have not been assessed as part of this study.

Recommendation 9: Work with the Environment Agency to incorporate any findings from the SWMP into SFRAs and other river modelling projects.

3.8 Critical Drainage Areas

3.8.1 As shown in Figure 3.2.1, 12 Critical Drainage Areas (CDAs) have been identified within or crossing the administrative boundary of London Borough of Sutton. Sutton Council has been identified as the 'lead' authority in terms of managing flood risk within these CDAs, though it will be necessary to work in partnership with other Boroughs to manage flood risk within several of the CDAs.

3.8.2 The remainder of this Chapter provides a description of each Critical Drainage Area including details of the flooding mechanisms and interaction between flooding locations within the CDA, the level of validation, any specific assumptions made, and the number and types of receptors identified to be at risk.

Property Counts

3.8.3 Pluvial modelling completed as part of Phase 2 of the Drain London Project affords an improved understanding of the level of flood risk facing the London Borough of Sutton. In order to provide a quantitative indication of potential risks, a property count for all return periods modelled as part of the Drain London project for the entire London Borough of Sutton has been undertaken and is shown in Table 3-5. This has been undertaken using the Environment Agency's National Receptors Dataset (NRD) and follows the methodology defined in the Drain London Data and Modelling Framework.

Table 3-5 Drain London Tier 2 Pluvial Modelling Property Count for the 1% AEP rainfall event

Property Type	Sub Category*	No. of properties flooded >0.03m**	No. of properties flooded >0.5m***
Infrastructure (PPS25 Categories)	Essential Infrastructure	27	4
	Highly Vulnerable	3	0
	More Vulnerable	111	5
	Other Infrastructure	67	0
Households	Deprived (All)	626	0
	Deprived (Basements)	0	0
	Non-Deprived (All)	28,422	335
	Non-Deprived (Basements)	11	0
Commercial / Industrial	Commercial/Industrial (All)	1,516	38
	Commercial/Industrial Basements	20	0
Other		28	1
	TOTAL	**30,800**	**383**

* A full description of the sub-categories is included in Table 3-7 at the end of this Chapter.

** Building thresholds have been represented in the modelling as 'stubs' raised 100mm above the average ground level within the building footprint. A depth of >0.03m will result in a water level 0.03m above the property threshold, which is therefore considered to flood.

*** Buildings where the average depth of flooding across the building footprint is greater than 0.5m.

3.8.4 To provide an indication of the spatial flood risk across the Borough, a property count has been undertaken within each of the CDAs in the London Borough of Sutton for the 1 in 100 year (1% AEP) event. These values are included in the following sections for each CDA and a full summary is included in Table 3-7 at the end of this Chapter.

3.8.5 It is important to note that the counts have been undertaken on a CDA basis, and therefore, for those cross boundary CDAs, not all flooded properties will lie within the London Borough of Sutton administrative area.

Figures 3.8.1 – 3.8.12 show the modelling results for each CDA; two maps for each CDA have been included which show the depth and flood hazard rating during the rainfall event with a 1 in 100 chance of occurring in any given year (1% AEP).

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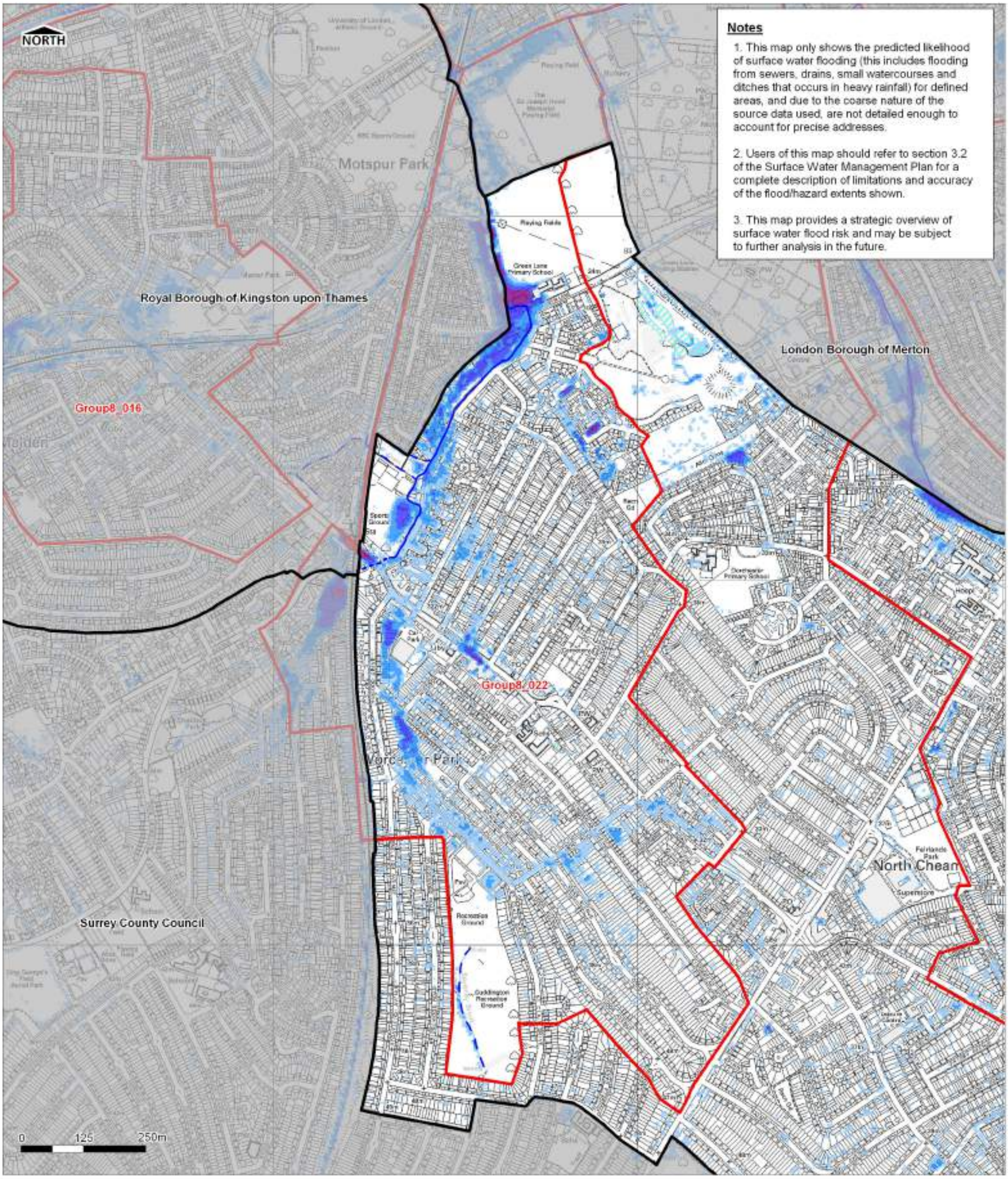

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:10,000	20/07/11	D.SKILTON	J.ROBINSON

Group8_022 (Worcester Park/Green Lane)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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Flood Risk Management
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

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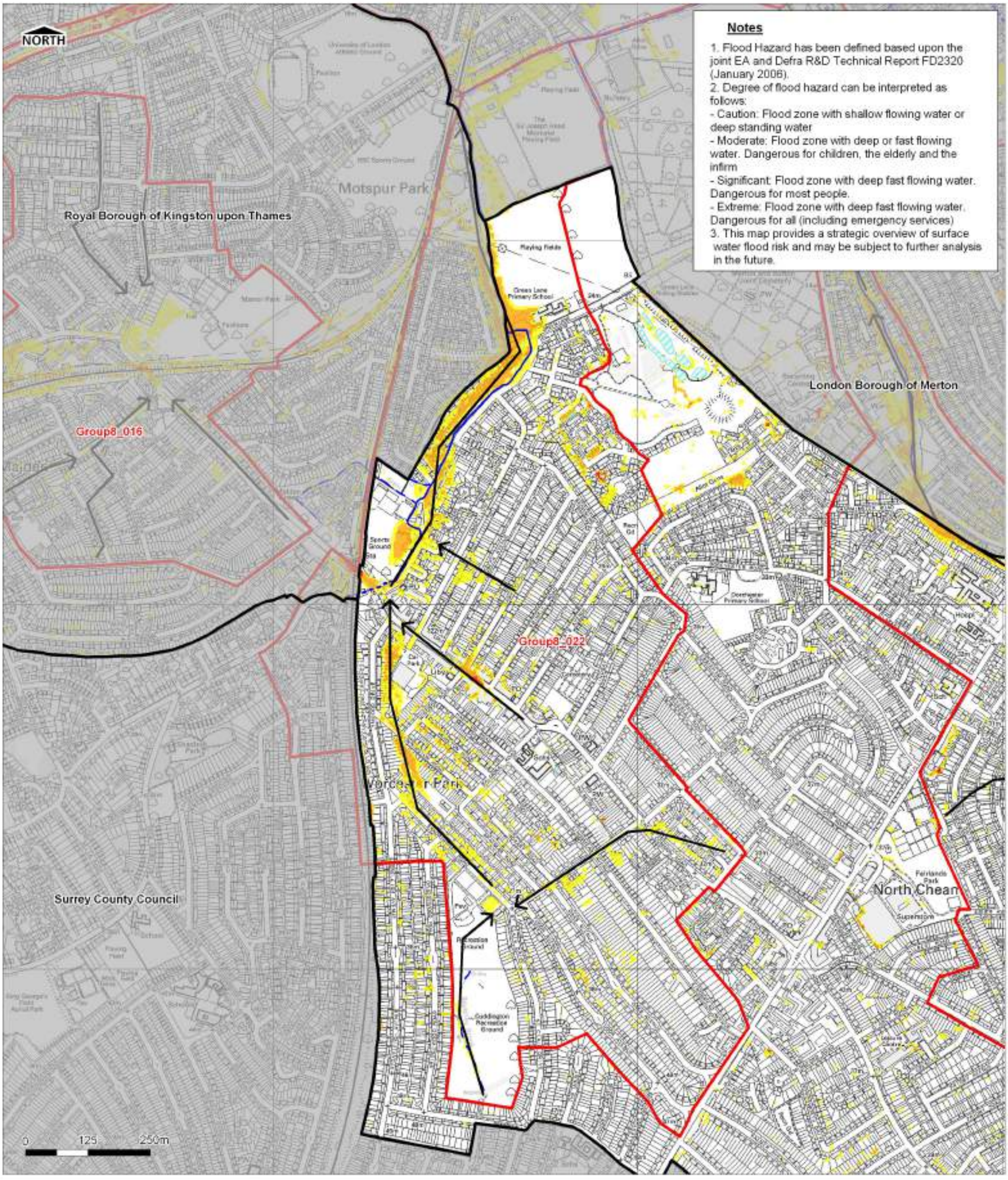
FIGURE 3.8.1a



Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
   - Caution: Flood zone with shallow flowing water or deep standing water
   - Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
   - Significant: Flood zone with deep fast flowing water. Dangerous for most people.
   - Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:10,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_022 (Worcester Park/Green Lane)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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Flood Risk Management
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6 - 8 Greencoat Place
London
SW1P 1PL

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FIGURE 3.8.1b

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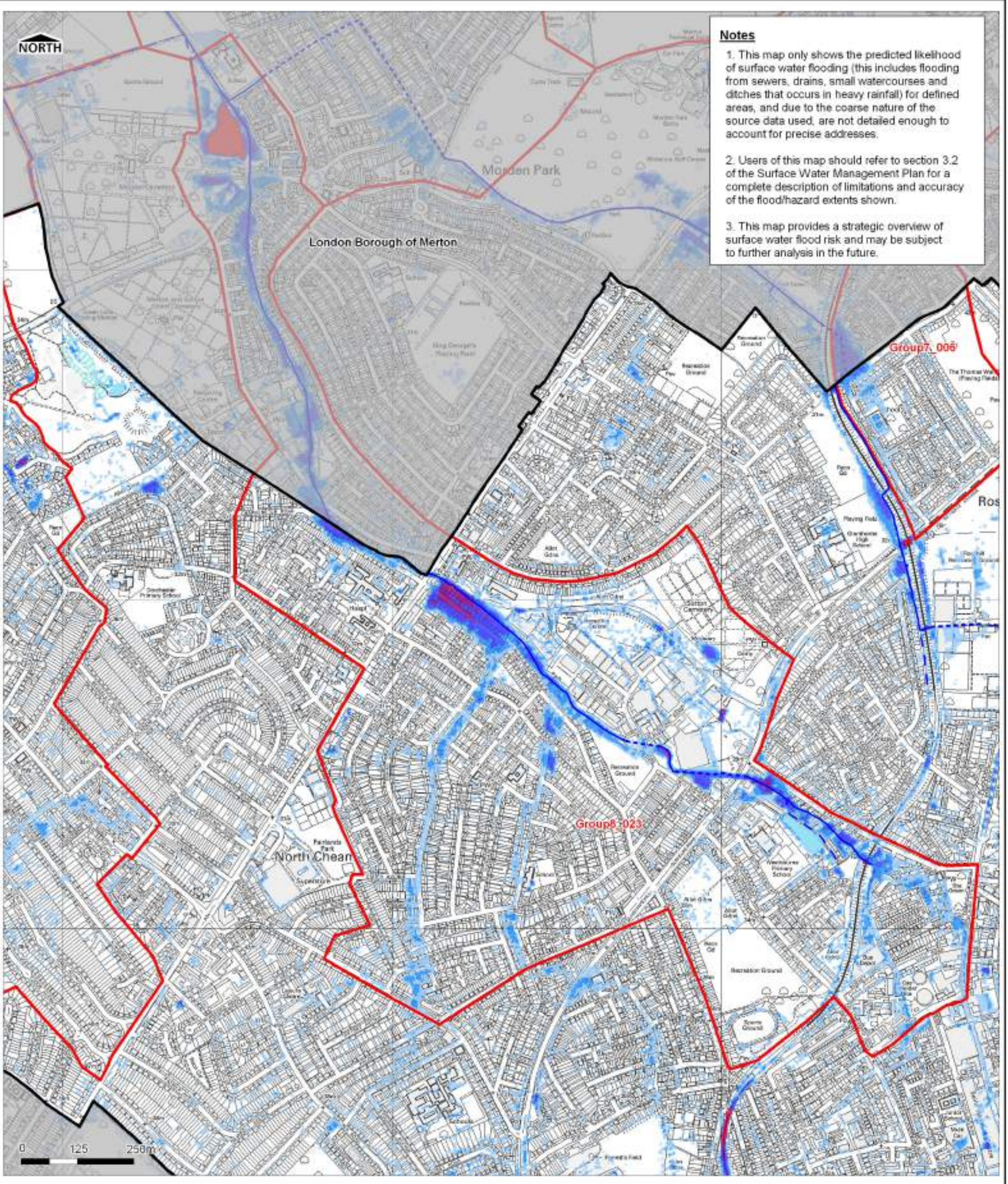

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.

2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Group8_023 (Trafalgar Avenue)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
CAPITA SYMONDS
Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

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Scale at A3	Date	Drawn by	Approved by
1:11,000	20/07/11	A.HARRIS	J.ROBINSON

FIGURE 3.8.2a

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

NORTH

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

Group7_006

Group8_023

Rosehill

North Cheam

Morden Park

0 125 250m

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:11,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_023 (Trafalgar Avenue)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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Flood Risk Management
URS / Scott Wilson
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London
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FIGURE 3.8.2b

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

Notes

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2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

Group8_025

Group8_024

0 125 250m

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Group8_024 (Sandy Lane)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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Scale at A3	Date	Drawn by	Approved by
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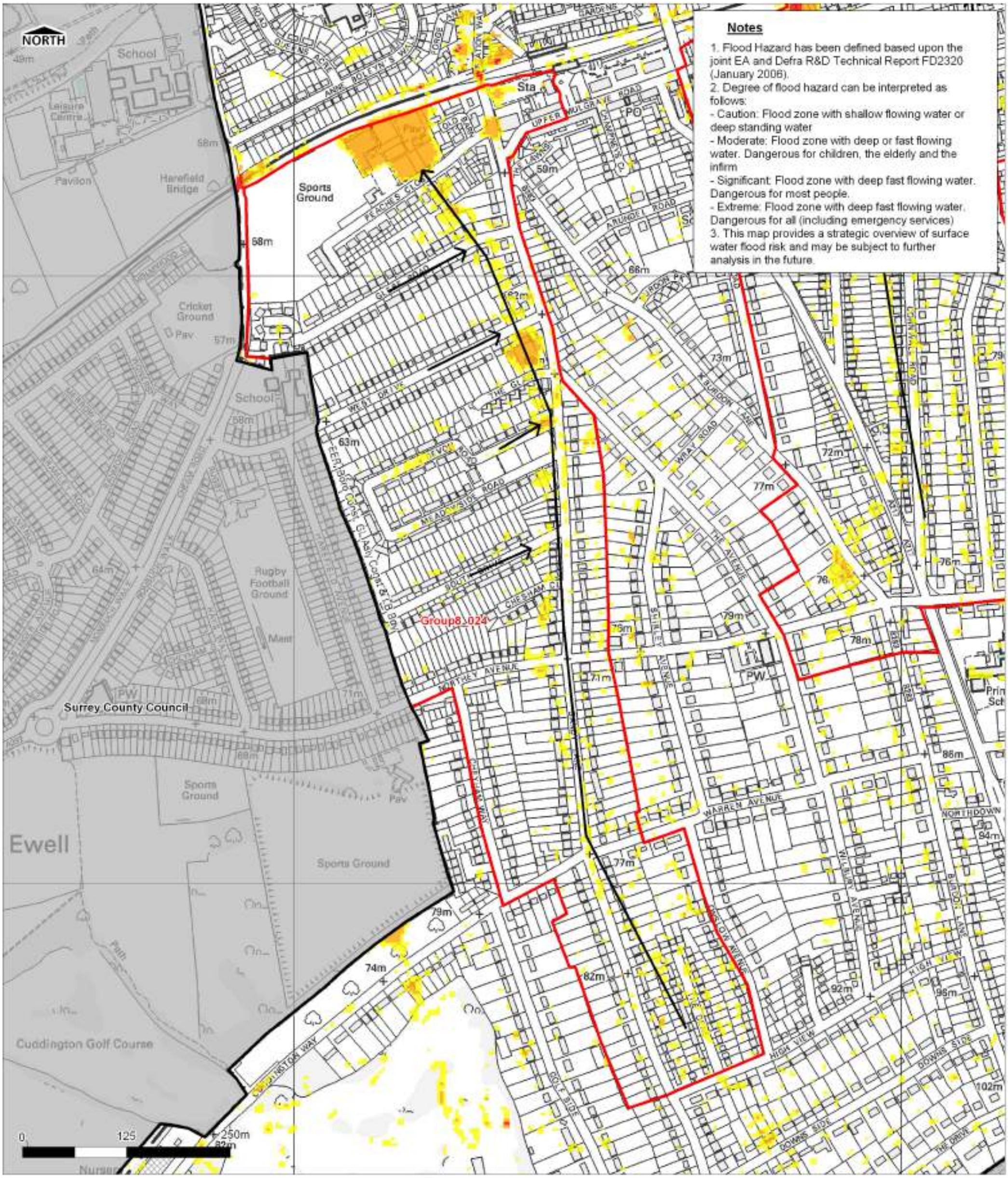
FIGURE 3.8.3a

File path: N:\Water\Current Projects\D1347\5 D1347\6 DRAIN LONDON\Tier 2\02 Group 8 (D1347\6\05 GIS



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:6,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_024 (Sandy Lane)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
CAPITA SYMONDS
Flood Risk Management
URS / Scott Wilson
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London
SW1P 1PL

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FIGURE 3.8.3b

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.

2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:5,000	20/07/11	A.HARRIS	J.ROBINSON

Group8_025 (York Rd/Mulgrave Rd)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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FIGURE 3.8.4a

Filepath: N:\Water\Current Projects\DI134785 DI134786 DRAIN LONDON Tier 2\02 Group 8 (DI134786)\05 GIS

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

Group8_025

Belmont

Overton Grange School

Sports Ground

Primary School

0 125 250m

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:5,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_025 (York Rd/Mulgrave Rd)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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Flood Risk Management
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London
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FIGURE 3.8.4b

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

NORTH

SUTTON

Revell Road (LFRZ)

Group8_025

Group8_026

Group8_027

Belmont

Heath Drive (LFRZ)

The Gallop (LFRZ)

The Linkway (LFRZ)

Chiltern Road (LFRZ)

0 125 250m

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.

2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:10,000	20/07/11	A.HARRIS	J.ROBINSON

Group8_026 (Sutton Junction)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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FIGURE 3.8.5a

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:10,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_026 (Sutton Junction)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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Flood Risk Management
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FIGURE 3.8.5b

Filepath: I:\5004 - Information Systems\D134785 D134786 DRAIN LONDON Tier 2\02 Workspaces\Lambeth Figure 3.8.4b Sutton Junction Surface Flood Hazard.wor

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.

2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Group8_027 (Carshalton Beeches) Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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London
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Scale at A3	Date	Drawn by	Approved by
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FIGURE 3.8.6a

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

Group8_027

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:6,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_027 (Carshalton Beeches) Surface Water Flood Hazard Rating 1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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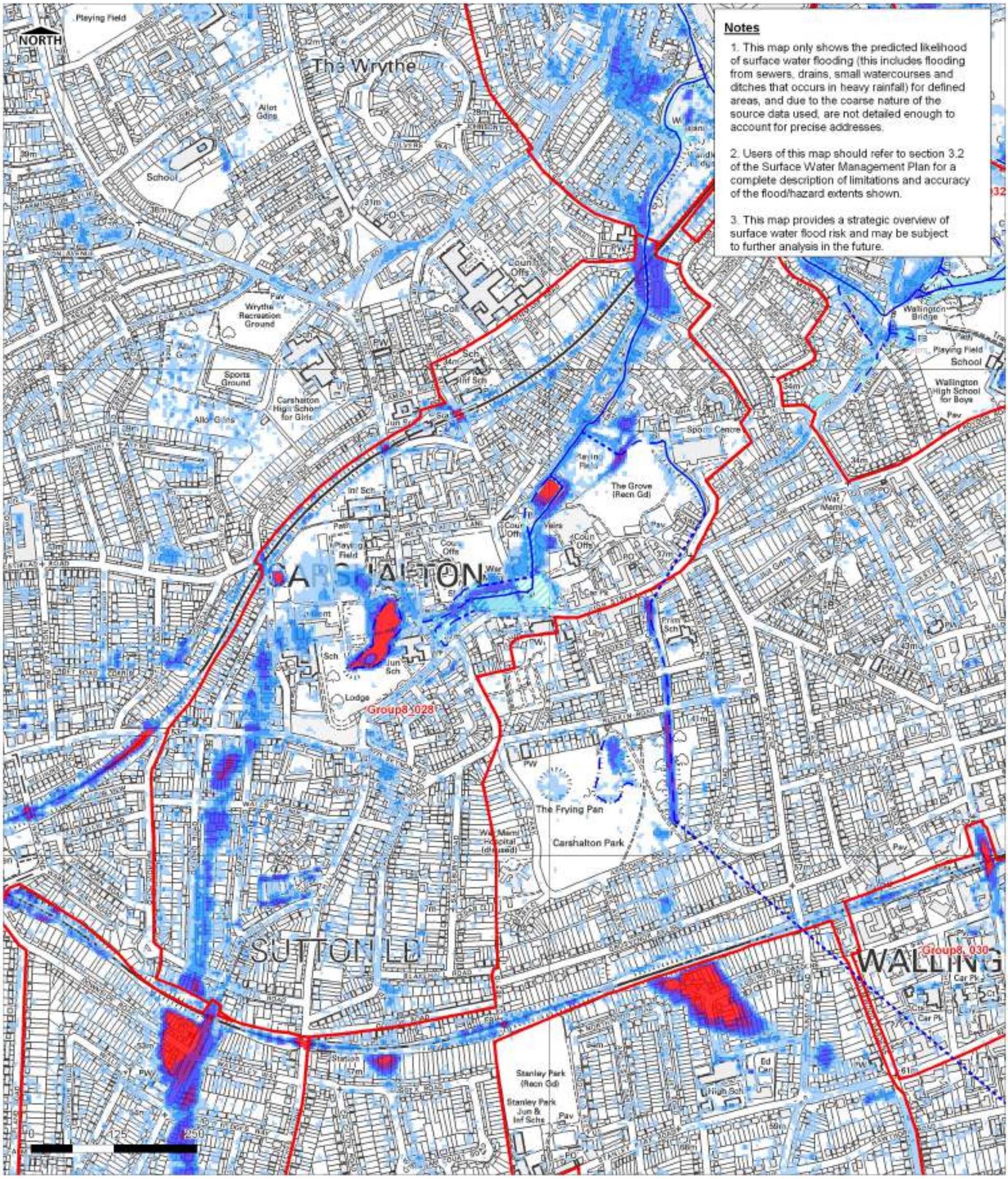
FIGURE 3.8.6b



Notes

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2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:,7,500	20/07/11	A.HARRIS	J.ROBINSON

Group8_028 (Carshalton Centre)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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FIGURE 3.8.7a

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:5,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_028 (Charshalton Centre)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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FIGURE 3.8.7b

Notes

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2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

Group8_029

Carshalton on the Hill

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:4,500	20/07/11	A.HARRIS	J.ROBINSON

Group8_028 (Beddington Gardens)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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Flood Risk Management
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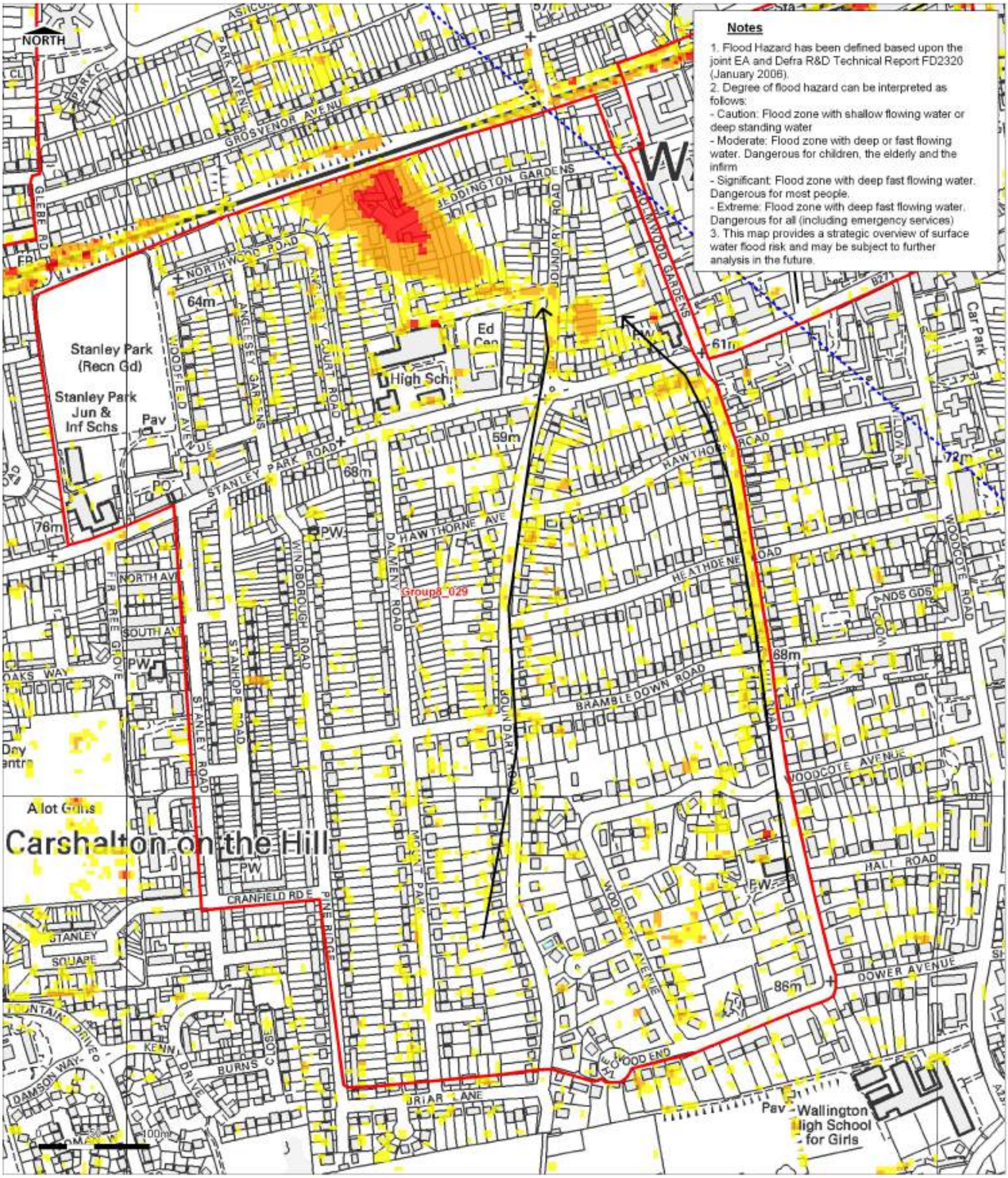
FIGURE 3.8.8a

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:4,500	20/07/2011	A.HARRIS	J.ROBINSON

Group8_029 (Beddington Gardens)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
CAPITA SYMONDS
Flood Risk Management
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

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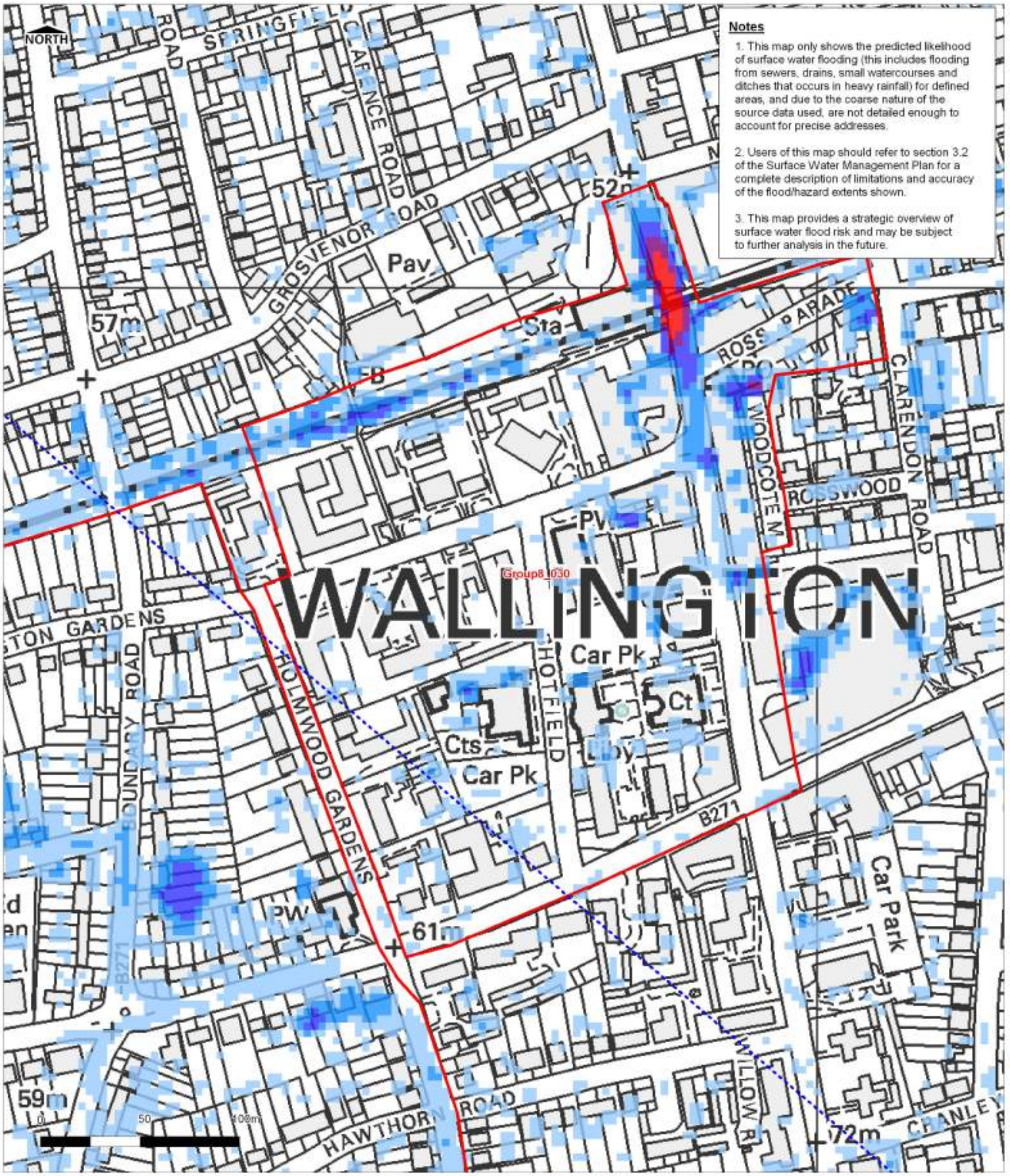
FIGURE 3.8.8b



Notes

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2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:2,500	20/07/11	A.HARRIS	J.ROBINSON

Group8_030 (Wallington Station)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
CAPITA SYMONDS
Flood Risk Management
URS / Scott Wilson
6 - 8 Greencoat Place
London
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FIGURE 3.8.9a

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Group8_030 (Wallington Station)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
CAPITA SYMONDS
Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

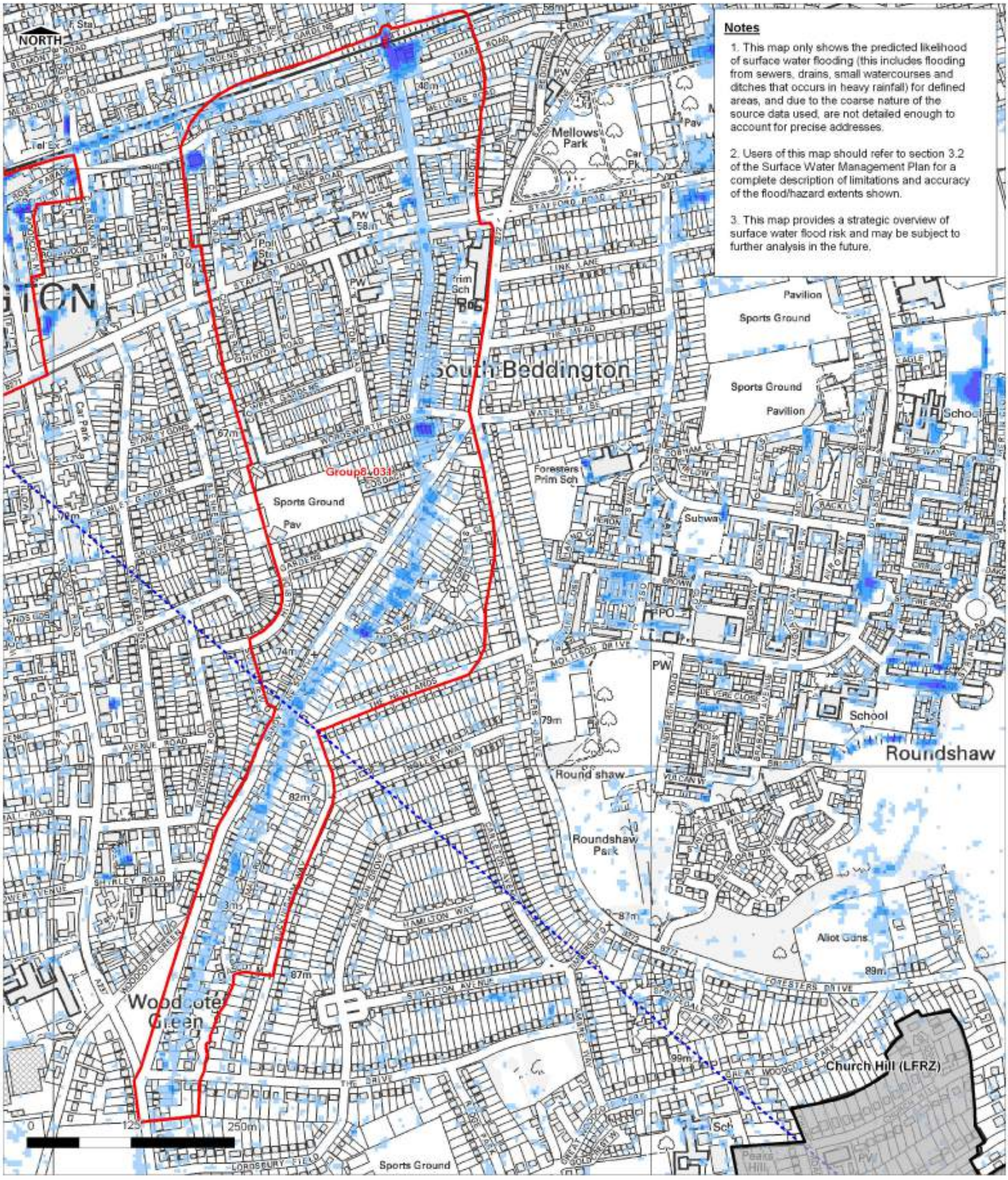
Drain London Programme Board Members

Environment Agency | Thames Water | LONDON COUNCILS | GREATERLONDONAUTHORITY

Scale at A3	Date	Drawn by	Approved by
1:2,500	20/07/2011	A.HARRIS	J.ROBINSON

FIGURE 3.8.9b

Filepath: I:\5004 - Information Systems\D134785 D134786 DRAIN LONDON Tier 2\02 Workspaces\Sutton Figure 3.8.11b Wallington Station Surface Flood Hazard.wor



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:6,000	20/07/11	A.HARRIS	J.ROBINSON

Group8_031 (Sth Beddington)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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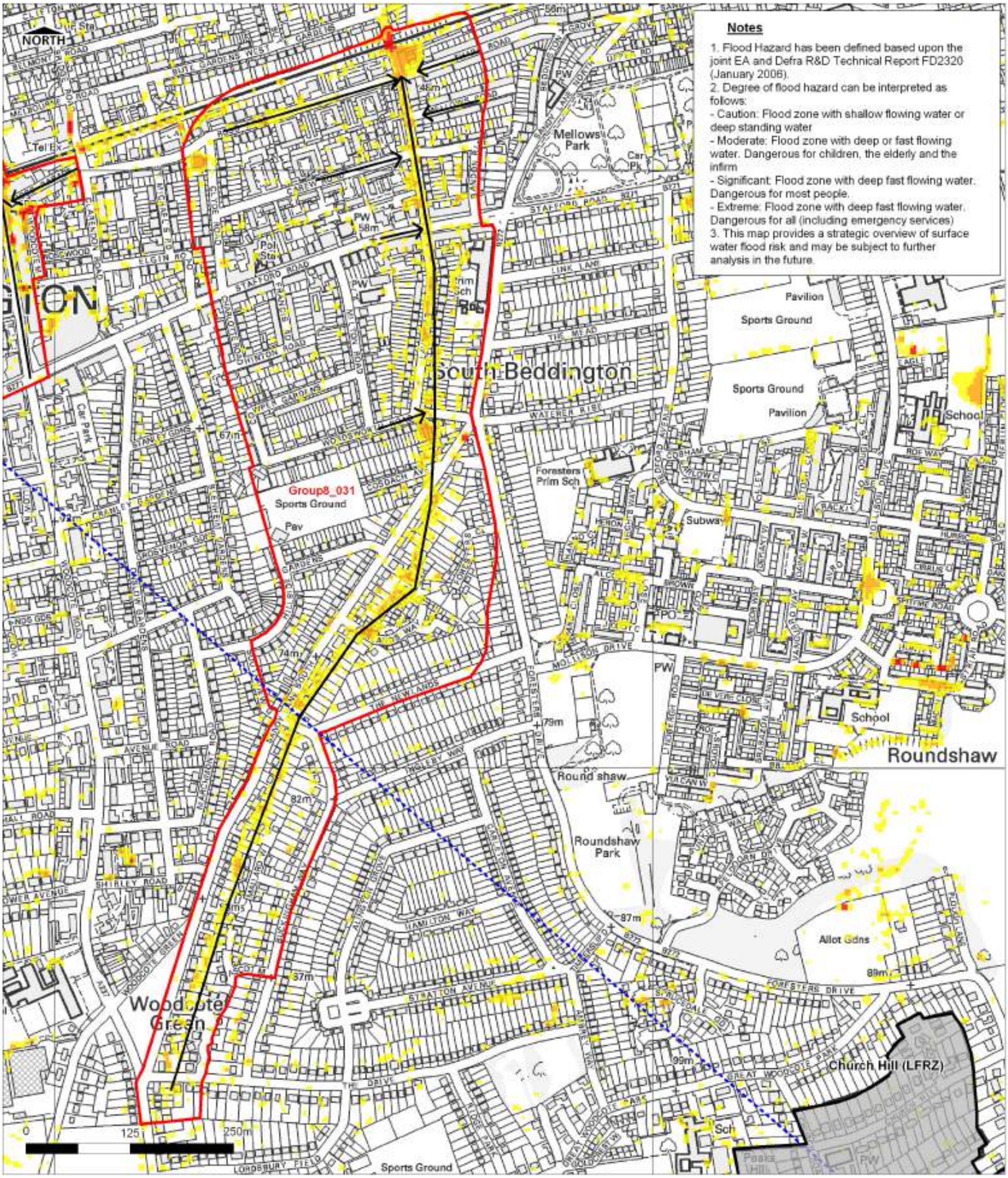
FIGURE 3.8.10a

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.



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Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:6,000	20/07/2011	A.HARRIS	J.ROBINSON

Group8_031 (Sth Beddington)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

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FIGURE 3.8.10b

Filepath: I:\5004 - Information Systems\D134785 D134786 DRAIN LONDON Tier 2\02 Workspaces\Sutton Figure 3.8.12b Sth Beddington Surface Water Flood Hazard.wor

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.

2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.

3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

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Legend

- Borough Administrative Boundary
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- Permanent Water Bodies
- Main River
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Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Group8_032 (Beddington Park)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

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Scale at A3	Date	Drawn by	Approved by
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FIGURE 3.8.11a

Filepath: N:\WaterCurrent Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

Notes

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3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

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Legend

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- Critical Drainage Area
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- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:4,500	20/07/2011	A.HARRIS	J.ROBINSON

Group8_032 (Beddington Park)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

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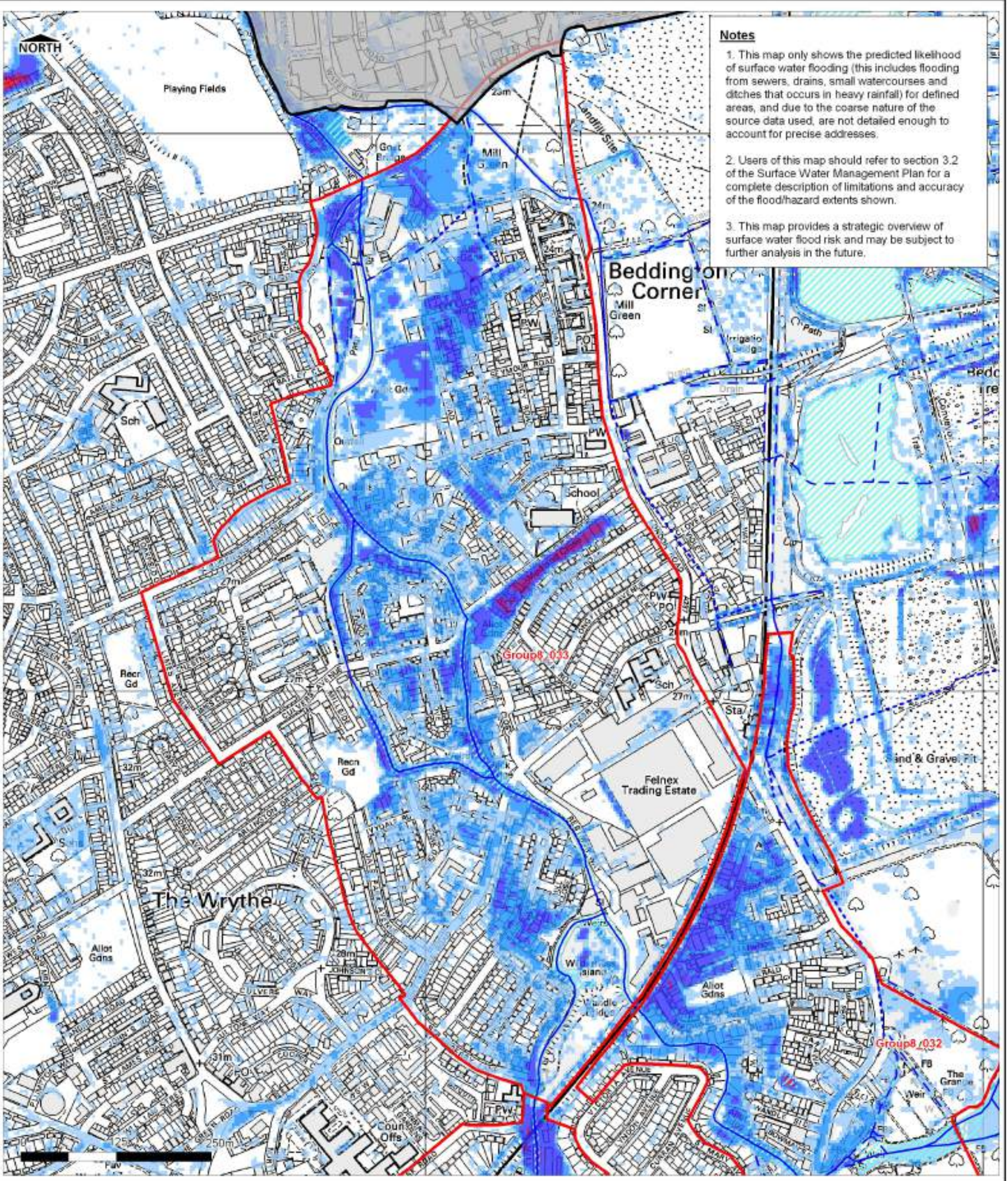
FIGURE 3.8.11b



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Flood Depth

- <0.1m
- 0.1m to 0.25m
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- 1.0m to 1.5m
- >1.5m

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:,6,500	20/07/11	A.HARRIS	J.ROBINSON

Group8_033 (Hackbridge)
Surface Water Depth (m)
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

Consultants
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FIGURE 3.8.12a

Filepath: N:\Water\Current Projects\D134785 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

Notes

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2. Degree of flood hazard can be interpreted as follows:
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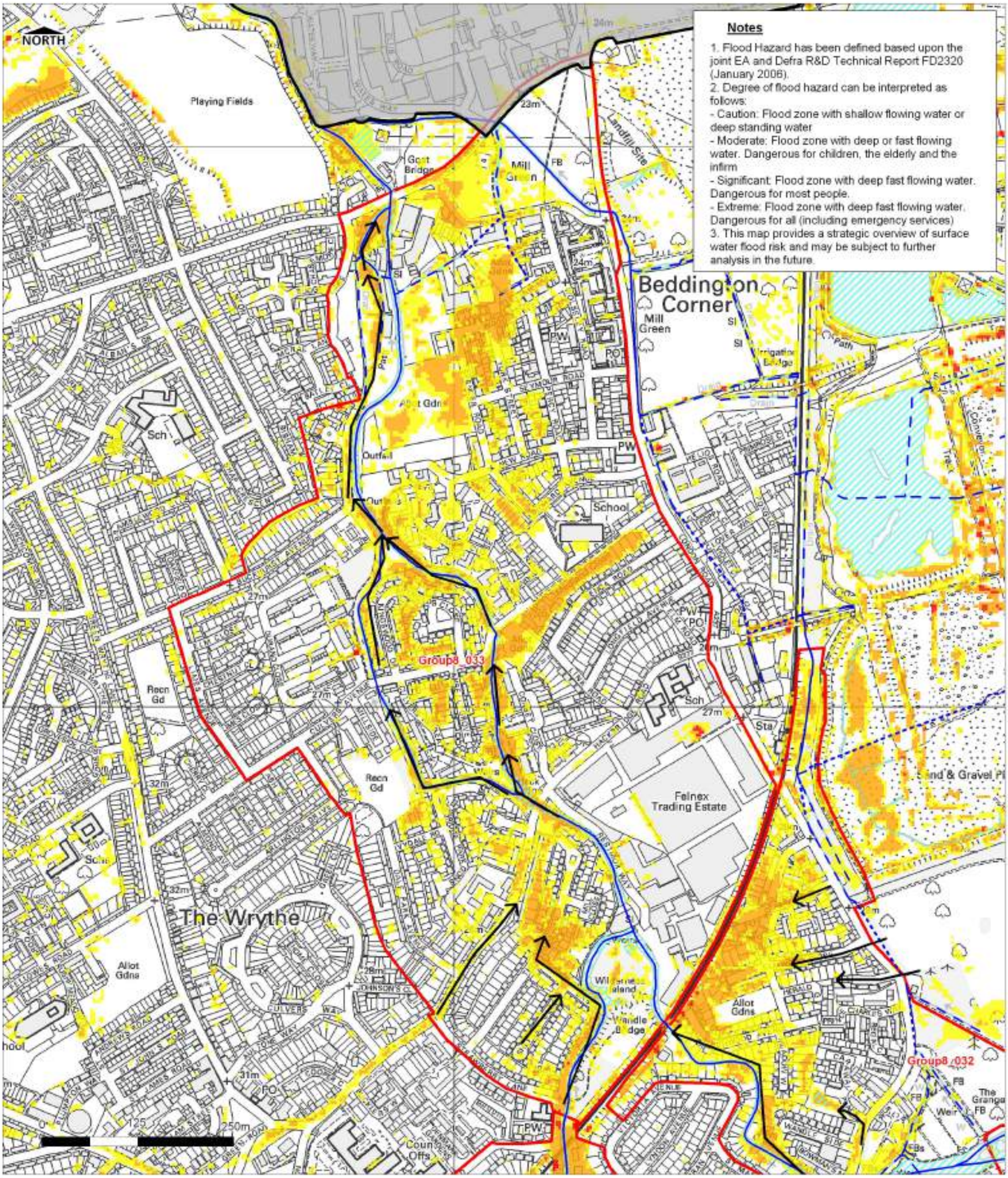
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.



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Legend

- Borough Administrative Boundary
- Critical Drainage Area
- Permanent Water Bodies
- Main River
- Ordinary Watercourse
- Culverted Watercourse
- Flow Direction Arrows

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

London Borough of Sutton

Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:6,500	20/07/2011	A.HARRIS	J.ROBINSON

Group8_033 (Hackbridge)
Surface Water Flood Hazard Rating
1 in 100 Chance of rainfall event occuring in any given year (1% AEP)

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FIGURE 3.8.12b

CDA 022 WORCESTER PARK / GREEN LANE

3.8.6 The primary flood source in this CDA is fluvial flooding from the Beverley Brook. London Borough of Sutton holds historic records of flooding in Caverleigh Way, Beverley Gardens and Green Lane which date back to the 1960s and relate to water levels in the brook rising and overtopping along much of the length which runs parallel to Green Lane.

Figure 3-6 Flooding on Green Lane, Worcester Park (Photos supplied by LB Sutton)

3.8.7 Furthermore, fluvial flooding and elevated river levels in this location has a limiting effect on local surface water drainage as surface water is often unable to discharge to the watercourse during periods of high water level resulting in localised surcharging and backing up of water through the surface water drainage system.

3.8.8 Whilst the primary flood source affecting the area is fluvial, there are some surface water flow paths within the CDA that contribute to the flood risk area on Green Lane. Surface water is modelled to affect Dalmany Road, the rear gardens of properties on Lynwood Drive, Sandringham Road, Donnington Road and Central Road.

3.8.9 Pluvial modelling results identify surface water flood risk along the Beverley Brook corridor attributed to lower ground levels associated with this area. Flow data identifies that during a surface water flood event, water would flow onto Green Lane from the south and would pool under the Central Road railway crossing at Worcester Park rail station. Pluvial modelling also highlights that there are potential flooding hot spots away from the Beverley Brook in locations such as Buckland Way.

3.8.10 Flow paths are present from adjacent areas including Woodlands Avenue and Avon Close which has been identified as a flooding hot spot by neighbouring Council Epsom and Ewell District.

3.8.11 This CDA is not identified within an area of increase Potential for Elevated Groundwater (iPEG); however there is one record of groundwater flooding on Hampton Road. Records of sewer flooding provided by Thames Water show that there are 21-50 incidents of sewer flooding within the post code areas in which the CDA is located. This highlights the multiple and complex interactions of flooding mechanism in this CDA.

Group8_022 Worcester Park		
LLFA	London Borough of Sutton (Lead) Royal Borough of Kingston Epsom & Ewell / Surrey County Council	
Flood Risk Categorisation:	Fluvial (Beverley Brook); Surface Water; Sewer Flooding; Groundwater	
Property Count	Approximately 1915 Non-deprived households and 139 commercial properties are flooded to a depth of greater than 0.03m. Of these, approximately 10 households and 20 commercial properties are basements.	Approximately 27 Non-deprived households flooded to a depth of greater than 0.5m.
Critical Infrastructure	Worcester Park Rail Station Police Station, Green Lane Health Surgery, Central Road	Community Centre on Braemar Road 4 Electricity substations
Validation	There are 36 records of flooding in the CDA; flooding is recorded to be from multiple sources along Caverleigh Way, Beverley Gardens, Green Lane, Hazlemere Gardens, Cheam Common Road, Donnington Road and Sandringham Close. There is one record of groundwater flooding on Hampton Road. There are 21-50 records of sewer flooding in the post code areas in which the CDA lies.	
Assumptions	N/A	
Figures	Figure 3.8.1a – Surface Water Depth (1% AEP) Figure 3.8.1b – Surface Water Flood Hazard (1% AEP)	

CDA 023 TRAFALGAR AVENUE / HAMILTON AVENUE

3.8.12 Flooding in Trafalgar Avenue is largely attributed to fluvial flooding from the Pyl Brook which flows in an open channel parallel to Trafalgar Avenue. During periods of heavy rainfall, water levels in the brook rise and overtop the banks flowing onto Trafalgar Avenue. The photographs below show the location of houses in relation to the Pyl Brook and the extent of flooding in July 2007.

Figure 3-7 a) The Pyl Brook & Trafalgar Ave b) Hamilton Avenue in July 2007

3.8.13 Pluvial modelling identifies flooding on Stayton Road adjacent to the Anton Crescent storage area operated by the Environment Agency. This 1.5 hectare storage area is designed to reduce peak storm flows from the Pyl Brook through attenuation measures. It is underlain by clay and has a pond which holds water all year round.

3.8.14 Flooding further up the catchment in this CDA is attributed to pluvial flooding; the modelling results show surface water ponding along Church Hill Road, Buxton Crescent, Henley Avenue and Kingston Avenue, flow paths which continue to join the Pyl Brook.

3.8.15 The flow paths along Kingston Avenue and Henley Avenue as well as the route of the Pyl Brook are identified to be areas with increase Potential for Elevated Groundwater and there is one record of groundwater flooding off Conrad Drive towards the western edge of the CDA. Thames Water sewer flooding records identify 21-50 records of sewer flooding within the post code areas within the CDA.

Group8_023 Trafalgar Avenue / Hamilton Avenue		
LLFA	London Borough of Sutton and London Borough of Merton	
Flood Risk Categorisation:	Fluvial (Pyl Brook) Surface Water	
Property Count	Approximately 2378 Non-deprived households, 4 deprived households and 102 commercial properties are flooded to a depth of > 0.03m.	Approximately 45 Non-deprived households flooded to a depth of greater than 0.5m.
Critical Infrastructure	Hospital Electricity substation	Community Centre
Validation	Fluvial flooding records; Trafalgar Avenue, Hamilton Avenue. Pluvial flooding records; Church Hill Road, Buxton Crescent, Wrayfield Road. Sewer flooding records; Hamilton Avenue. Groundwater flooding; Conrad Drive.	
Figures	Figure 3.8.2a – Surface Water Depth (1% AEP) Figure 3.8.2b – Surface Water Flood Hazard (1% AEP)	

CDA 024 SANDY LANE

3.8.16 This CDA is located on the south western boundary of the Borough. Sandy Lane forms an overland flow route for surface water which is shown to result in ponding in gardens and properties at West Drive, Glebe Road and Peaches Close and to pond in the area of the Nuffield Health and Sports Centre on Peaches Close which is the primary LFRZ in this CDA. Water is modelled to pond behind the railway embankment reaching depths of more than 0.5m.

3.8.17 The northern part of this CDA is shown to be within an area of increased Potential for Elevated Groundwater. There are no records of groundwater or sewer flooding in this CDA.

Group8_024 Sandy Lane		
LLFA	London Borough of Sutton	
Flood Risk Categorisation:	Surface Water	
Property Count	Approximately 308 Non-deprived households are flooded to a depth of greater than 0.03m.	Approximately 1 Non-deprived household and 2 commercial properties are flooded to a depth of greater than 0.5m.
Critical Infrastructure	N/A	
Validation	Pluvial flooding records on Peeches Close.	
Assumptions	It is assumed there are no culverts through the railway embankment at this location.	
Figures	Figure 3.8.3a – Surface Water Depth (1% AEP) Figure 3.8.3b – Surface Water Flood Hazard (1% AEP)	

CDA 025 York Rd / Mulgrave Rd

3.8.18 This CDA is located to the south east of Sutton town centre. The CDA contains two small LFRZs, one located adjacent to the railway embankment on Mulgrave Road and one at the crossing of the railway line on York Road. The local topography results in overland flow from the residential area flowing northwards and backing up in topographical low points and where the railway embankment forms a barrier to further movement of water. Worcester Road, which adjoins York Road, is identified by London Borough of Sutton as one of their priority areas for gully maintenance and is targeted in general maintenance as well as during heavy rainfall events.

3.8.19 A small part of this CDA is shown to be within an area of increased Potential for Elevated Groundwater. There are no records of groundwater or sewer flooding in this CDA.

Group8_025 York Road / Mulgrave Road		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Surface Water	
Property Count	Approximately 476 Non-deprived households are flooded to a depth of greater than 0.03m.	Approximately 16 Non-deprived household flooded to a depth of greater than 0.5m.
Critical Infrastructure	Railway infrastructure Residential Home, Dorset Road	
Validation	Pluvial flooding recorded on Mulgrave Road and Worcester Park.	
Assumptions / Comments	It is assumed there are no culverts through the railway embankment at this location.	
Figures	Figure 3.8.4a – Surface Water Depth (1% AEP) Figure 3.8.4b – Surface Water Flood Hazard (1% AEP)	

CDA 026 Sutton Junction

3.8.20 Pluvial modelling of this area suggests that surface water may pool in the Cedar Road/Wellesley Road area at Sutton Junction. This is supported by information supplied by the local drainage engineer who reports that there is localised surface water flooding at this location as water pools in the road when the capacity of the road drainage system is exceeded. Reportedly, surface water flows from the highway, onto the pavement and affects local property. A further issue reported is the design of the surface water sewer at this location which passes through a 90 degree bend (as shown in Figure 3-8) causing water to surcharge onto the highway. It is understood that the Council has made capital investments in this area and have built extra gullies and soakaways to help alleviate the problem.

3.8.21 Surface water is also modelled to pond where in the underpasses where the railway lines cross roadways, for example at Grange Vale and Bridge Road. Further south in the CDA, the modelling suggests that runoff generated in Reigate and Banstead may flow into London Borough of Sutton. The LLFA for this area is Surrey County Council.

3.8.22 The Sutton Junction LFRZ is shown to be located within an area of increased Potential for Elevated Groundwater.

3.8.23 Moorland Road is identified as another LFRZ within this CDA. This location has suffered from surface water flooding in the past as the western end of the road is located in a hollow. Reportedly surface water flows along Langley Park Road to Moorland Road where property

has been flooded. The original piped surface water drainage system carried surface water to the east along Moorland Road to connect to the main carrier pipe in Carshalton Road.

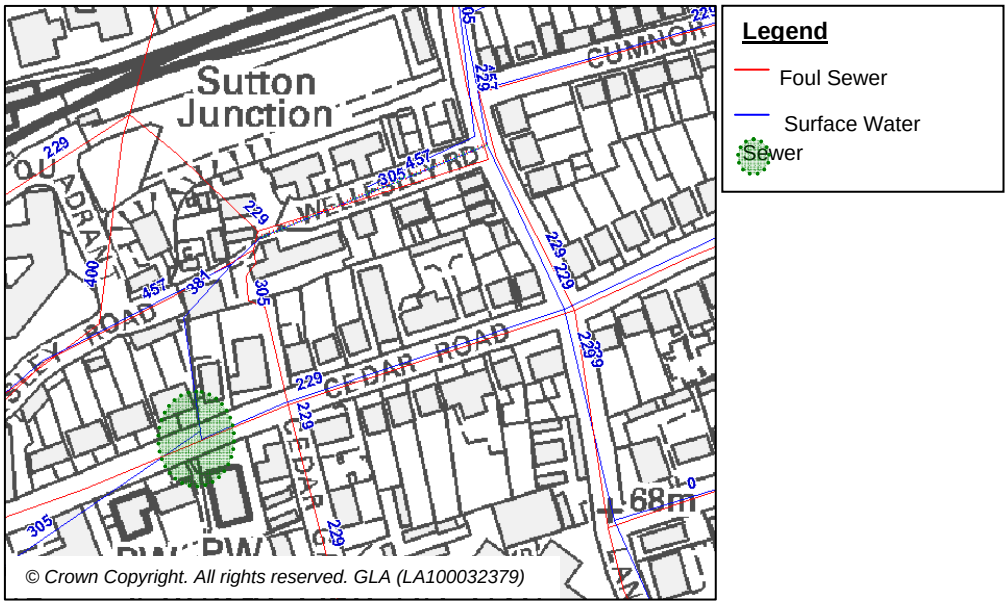

Figure 3-8 Thames Water Network Plan, Cedar Road, Sutton Junction

3.8.24 Following surface water flooding, London Borough of Sutton has completed remediation works in this area to include the addition of new stand alone soakaways and a gully system in Moorlands Road which is linked into the surface water drainage system in Langley Park Road. In addition, new double gullies have been located on Langley Park Road to 'catch' as much surface water as possible before it flows into Moorland Road. Pluvial modelling highlights the potential for water to pool in the Moorland Road area which could reach a depth of 0.5m in places.

3.8.25 Thames Water sewer flooding records identify approximately 6-10 records of sewer flooding within the post code areas in which the CDA is located.

Group8_026 Sutton Junction		
Lead Borough	London Borough of Sutton (Surrey County Council)	
Flood Risk Categorisation:	Surface Water Sewer Flooding	
Property Count	Approximately 2113 Non-deprived households and 49 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 43 Non-deprived household flooded to a depth of greater than 0.5m.
Critical Infrastructure	Sutton Rail Station and associated electricity substations (6) Sutton Hospital Royal Marsden Hospital and associated electricity substations.	
Validation	Pluvial flooding recorded on Morland Road, Cedar Road, Heath Drive, Chiltern Road, Cambourne Road, Christchurch Park, Furzedown Road, Sutton Hospital, Grange Vale, Egmont Road and Brighton Road. Records of sewer flooding on Cedar Road. Records of 10 properties experiencing sewer flooding in the post code area in which the CDA is located.	
Figures	Figure 3.8.5a – Surface Water Depth (1% AEP) Figure 3.8.5b – Surface Water Flood Hazard (1% AEP)	

CDA 027 CARSHALTON BEECHES

3.8.26 This CDA is located in the centre of the Borough to the south of the railway line. Surface water flow travels in a northerly direction in the vicinity of Woodmansterne Road to a flood risk area located at Barrow Hedges Primary School. The flow path then continues north to a LFRZ located at Downside Road and Banstead Road, adjacent to the railway embankment.

3.8.27 There are records of pluvial flooding at this location as well as on Willis Avenue, to the south of the LFRZ. There are also records of surface water flooding in the wider Carshalton Beeches area where overland flows fail to enter the drainage network (due to steep gradients) and results in inundation of properties located in topographical low points.

3.8.28 Thames Water have records of sewer flooding affecting properties in this CDA and the route of the overland flow route towards Downside Road is located in an area of increased potential for elevated groundwater (iPEG).

Group8_027 Carshalton Beeches		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Surface Water	
Property Count	Approximately 623 Non-deprived households and 29 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 49 Non-deprived households and 24 commercial properties are flooded to a depth of greater than 0.5m.
Critical Infrastructure	Residential Home, Waverley Road Health care centre / surgery Community Centre, Banstead Road Barrow Hedges Primary School	
Validation	Pluvial flooding incidents recorded on Banstead Road and Willis Avenue.	
Assumptions	N/A	
Figures	Figure 3.8.6a – Surface Water Depth (1% AEP) Figure 3.8.6b – Surface Water Flood Hazard (1% AEP)	

CDA 028 CARSHALTON CENTRE

3.8.29 Carshalton has been identified as a CDA within which there is an interaction of several sources of flooding. There are a number of springs that form the headwaters of the Carshalton Branch of the River Wandle and the Environment Agency hold records of groundwater flooding in this location. The CDA is identified to lie within an area of increased potential for elevated groundwater (iPEG).

3.8.30 A small section of the north eastern corner of this CDA is identified as being within Flood Zone 2, however the extent of flooding identified through pluvial modelling greatly exceeds the Flood Zone outline.

3.8.31 Pluvial modelling shows ponding of surface water along Oxford Road, Wales Avenue, Beynon Road, Shorts Road, West Street and North Street.

3.8.32 The area surrounding Mill Lane in the north of the CDA is a well known LFRZ and becomes impassable for vehicles during heavy rainfall events resulting in considerable disruption to the wider transport network. At this location the watercourse flows adjacent to the highway and there is potential for surface water flooding to be compounded by fluvial flooding.

Group8_028 Carshalton Centre		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Surface Water Groundwater Sewer	
Property Count	Approximately 975 Non-deprived households and 68 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 32 Non-deprived household flooded to a depth of greater than 0.5m.
Critical Infrastructure	Carshalton Rail Station Road Network at Mill Lane 2 Residential Homes, Salisbury Road	
Validation	Records of pluvial flooding on Carshalton High Street and Carshalton Park Road. Thames Water has records of 21-50 incidents of sewer flooding within the post code areas in which the CDA lies.	
Assumptions	N/A	
Figures	Figure 3.8.7a – Surface Water Depth (1% AEP) Figure 3.8.7b – Surface Water Flood Hazard (1% AEP)	

CDA 029 BEDDINGTON GARDENS

3.8.33 Pluvial modelling identifies potential surface water ponding in Beddington Gardens. Surface water is shown to flow north along Park Hill Road and Boundary Road towards Beddington Gardens and to pond against the railway embankment.

3.8.34 London Borough of Sutton holds records of pluvial flooding within this CDA, including property flooding on Boundary Road, Anglesey Court Road, Beddington Gardens and Stanley Park Road from pluvial and sewer sources.

3.8.35 Thames Water sewer flooding records identify this CDA to lie within a post code area with 11-20 properties known to have been affected by sewer flooding.

Group8_029 Beddington Gardens		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Surface Water Sewer Flooding	
Property Count	Approximately 548 Non-deprived households and 8 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 26 Non-deprived households flooded to a depth of greater than 0.5m.
Critical Infrastructure	Railway embankment	
Validation	Records of pluvial flooding on Boundary Road, Anglesey Court Road, Beddington Gardens and Stanley Park Road. 11-020 incidents of sewer flooding in the post code area in which the CDA is located.	
Assumptions / Comments	N/A	
Figures	Figure 3.8.8a – Surface Water Depth (1% AEP) Figure 3.8.8b – Surface Water Flood Hazard (1% AEP)	

CDA 030 WALLINGTON RAILWAY BRIDGE

3.8.36 The Manor Road (A237) underpass has been hollowed out to increase headroom underneath the railway parapet and surface water is modelled to pond to significant depths in this location. Local flood records validate this modelling, as shown in the photographs below which were taken in July 2007.

Figure 3-9 Flooding at Wallington Railway Bridge *(Source: www.yourlocalguardian.co.uk)*

3.8.37 During heavy rainfall, sheet flow is known to flow along Beddington Gardens and Ross Parade, as a result of inadequate drainage in these areas, and to flow down Manor Road towards Wallington Railway Bridge. At the low point in the highway there are two 15m deep soakaways which have an overflow that connects to the Thames Water foul drainage system. During severe rainfall events both of these systems are frequently inundated resulting in surface water flooding. Pressure in the Thames Water drainage system to the north of the railway line also leads to backing up and surcharging of the system in the raised footways underneath the Railway Bridge and displacement of manhole covers, as shown in the right hand photograph above. Following a rainfall event, flood water drains away within a few hours.

Group8_030 Wallington Railway Bridge		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Surface Water Flooding Sewer Flooding	
Property Count	Approximately 84 Non-deprived households and 73 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 5 Non-deprived households and 1 commercial property flooded to a depth of greater than 0.5m.
Critical Infrastructure	A237 Red Route Wallington Rail Station	
Validation	Records of pluvial and sewer flooding at Wallington railway bridge (Manor Way).	
Assumptions / Comments	N/A	
Figures	Figure 3.8.9a – Surface Water Depth (1% AEP) Figure 3.8.9b – Surface Water Flood Hazard (1% AEP)	

CDA 031 SOUTH BEDDINGTON

3.8.38 Within this CDA, pluvial modelling suggests that surface water flows north along Sandy Lane South and Lavender Vale and ponds in the railway underpass on Demesne Road. Ground levels suggest that water would pool to the south of the railway line at the junction with Ross Road and Tharp Road, which is verified by pluvial flooding records held by London Borough of Sutton. The northern part of this CDA is located within an area of increased potential for elevated groundwater (iPEG).

Group8_031 South Beddington		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Surface Water	
Property Count	Approximately 571 Non-deprived households and 52 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 9 Non-deprived households are flooded to a depth of greater than 0.5m.
Critical Infrastructure	Railway infrastructure Police Station Community Centre	
Validation	Pluvial flooding records on Carew Road and Tharp Road.	
Assumptions	N/A	
Figures	Figure 3.8.10a – Surface Water Depth (1% AEP) Figure 3.8.10b – Surface Water Flood Hazard (1% AEP)	

CDA 032 BEDDINGTON PARK

3.8.39 This CDA is located to the east of Beddington Park, just south of Hackbridge. The topography of this CDA is relatively flat shown by the pooling of water across much of the CDA. Generally surface water flows in a westerly direction and backs up behind the railway embankment. This area is largely included within the Environment Agency Flood Zone envelope associated with the River Wandle, as shown in Figure 3.7.1 and fluvial flooding is the primary flood source and mechanism within this CDA.

3.8.40 This CDA is also identified as lying within an area of increased potential for elevated groundwater.

Group8_032 Beddington Park		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Fluvial flooding – River Wandle Surface Water	
Property Count	Approximately 377 Non-deprived households and 10 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 27 Non-deprived households are flooded to a depth of greater than 0.5m.
Critical Infrastructure	N/A	
Validation	Pluvial flooding records along London Road and Riverside Close.	
Assumptions	N/A	
Figures	Figure 3.8.11a – Surface Water Depth (1% AEP) Figure 3.8.11b – Surface Water Flood Hazard (1% AEP)	

CDA 033 HACKBRIDGE

3.8.41 Flooding in Hackbridge is the result of a number of interacting sources including fluvial, surface water and groundwater sources. The Carshalton and Waddon branches of the River Wandle combine at Hackbridge and flow north west through Mitcham. The watercourse is fed by a series of springs in the area and receives surface water drainage throughout the catchment.

3.8.42 When the river is in flood, surface water drainage systems often become surcharged, preventing the outfall of storm water which can then back-up through the system and cause flooding elsewhere in the catchment.

Figure 3-10 Surface water outfall into River Wandle

3.8.43 Pluvial modelling highlights that there is risk of surface water flooding across the Hackbridge CDA. This is largely due to the shallow gradient and tendency for water to pond on the ground surface.

3.8.44 Records of flooding from multiple sources have been reported along Nightingale Close, Goat Road, Mullards Close, Orchard Avenue, Wood Street, Corbet Close, Eindhoven Close, Philips Close, Reynolds Close and Strawberry Lane. Thames Water has records of 21-50 incidents of sewer flooding in the post code areas that intersect the CDA.

3.8.45 The superficial deposits in this area are defined as water bearing and the underlying River Terrace Deposits are likely to be in some hydraulic continuity with the River Wandle and its tributaries. As a result Figure 3.5.1 identifies this CDA to be located within an area with increased potential for elevated groundwater. If the groundwater table rises to any degree there is a large risk of groundwater flooding adding to the existing surface water flooding potential.

Group8_033 Hackbridge		
Lead Borough	London Borough of Sutton	
Flood Risk Categorisation:	Fluvial – River Wandle Groundwater Sewer Surface Water	
Property Count	Approximately 1023 Non-deprived households and 68 commercial properties are flooded to a depth of greater than 0.03m.	Approximately 11 Non-deprived households and 1 commercial property are flooded to a depth of greater than 0.5m.
Critical Infrastructure	Electrical Substation, Wolseley Road	
Validation	Flooding from combined sources on Nightingale Close, Goat Road, Mullards Close, Orchard Avenue, Wood Street, Corbet Close, Eindhoven Close, Philips Close, Reynolds Close and Strawberry Lane.	
Assumptions / Comments	N/A	
Figures	Figure 3.8.12a – Surface Water Depth (1% AEP) Figure 3.8.12b – Surface Water Flood Hazard (1% AEP)	

Additional Local Flood Risk Zones

3.8.46 Several Local Flood Risk Zones (LFRZs) have also been identified in the Borough, which have not been identified within Critical Drainage Areas. As stated in Section 3.2.1, a LFRZ is defined as "a discrete area of flooding that affect houses, businesses or infrastructure". The following sections describe additional Local Flood Risk Zones within the Borough.

Local Flood Risk Zone – Revell Road

3.8.47 Cecil Road and Revell Road, located to the south west of Sutton Town Centre, and marked on Figures 3.8.5a and 3.8.5b, is a known LFRZ. Surface water at this location flows along Belmont rise and east along Cheam Road to form a pool in a low point in the highway at Revell Road.

Figure 3-11 Surface water flooding on Revell Road

3.8.48 The Council have installed linear drainage gullies to capture as much surface water drainage as possible. It should be noted that this solution is reliant on the Thames Water surface

water drainage system which in this location is served by a 600mm diameter pipe. If surface water flooding continues to be an issue in this location, there may be potential to install soakaways.

Figure 3-12 Linear Drainage Gullies, Revell Road

Local Flood Risk Zone – The Gallop, The Linkway, Heath Drive, Chiltern Road

3.8.49 Site inspections with London Borough of Sutton drainage engineer highlighted a further area where there is a history of surface water flooding to the south west of Carshalton Beeches. The area at risk includes The Gallop, The Linkway, Heath Drive and Chiltern Road, marked on Figures 3.8.5a and 3.8.5b.

3.8.50 Flooding in this area is caused by the local topography and large catchment areas created by the surrounding roads. During high intensity rainfall events, the velocity of the overland flow over the ground surface often prevents it from entering the gully pots.

3.8.51 London Borough of Sutton has invested in the local drainage along these four highways by incorporating extra gullies with 'cut ins' along local roads as illustrated in the photos below. These extra gullies reduce the impact of leaf litter on the drainage system and act to slow water, increasing the volume of water entering the gully pots. In addition to these measures, London Borough of Sutton has incorporated a 10m deep 2.5m wide soakaway at Heath Drive to prevent property flooding.

Figure 3-13 Drainage Improvement Works, The Gallop

Local Flood Risk Zone – Church Hill

3.8.52 London Borough of Sutton also has records of surface water flooding along Church Hill in the south west of the Borough. This LFRZ is on the boundary with London Borough of Croydon and is marked on Figures 3.8.10a and 3.8.10b. During heavy rainfall, surface water is unable to enter the drainage system quickly enough which results in ponding on the highway and flooding of walkways and properties.

Figure 3-14 Surface water flooding, Church Hill

3.9 SUMMARY OF RISK

3.9.1 The following conclusions can be drawn from the Phase 2 assessment, which has involved pluvial modelling combined with site visits and a review of historical flood records provided by the Council, Thames Water and the Environment Agency:

- Pluvial flooding is widely dispersed across the entire Borough.
- There are ten (10) discrete locations of surface water flooding either adjacent to the railway embankment or beneath railway crossings running roughly west to east through the centre of the Borough;
- There are at least six (6) of the higher risk areas are narrow linear corridors associated with topographic valleys, likely once occupied by rivers, running roughly from south to north through the Borough;
- Hackbridge is at risk of flooding from multiple and interlinked sources including overland flow, surcharging of sewer systems during high river levels and increased potential for elevated groundwater.

RISK TO EXISTING PROPERTIES & INFRASTRUCTURE

3.9.2 As part of the Phase 2 assessment, a quantitative assessment of the number of properties at risk of flooding has been undertaken for each CDA. The 1% AEP rainfall event has been used to inform this assessment, as specified in the Drain London Data and Modelling Framework.

3.9.3 A full summary of the results of the property count are included in Table 3-7 at the end of this Chapter.

3.9.4 The values in Table 3-7 identify that Carshalton Beeches, Sutton Junction and Trafalgar Avenue CDAs have the most number of residential properties at risk of flooding to a depth of greater than 0.5m, followed by Beddington Park and Worcester Park. Sutton Junction is

identified to have the greatest amount of infrastructure at risk.

4.1.2 It should also be noted that in the event of an extreme rainfall event across the Borough, there is a cumulative threat of multiple pieces of key infrastructure being affected by flooding. Across the CDAs within London Borough of Sutton, the following pieces of essential, highly vulnerable and more vulnerable infrastructure are identified to be at risk of flooding during the 1% AEP event.

- 3 Police Stations.
- 2 Hospitals.
- 11 Residential Care Homes.
- 25 Electricity Substations.
- 53 Educational Establishments.

3.9.5 This cumulative affect should be considered by the LLFA when considering emergency planning provisions across the Borough and in collaboration with neighbouring authorities.

RISK TO FUTURE PROPERTIES & INFRASTRUCTURE

3.9.6 The London Plan target for London Borough of Sutton, as set out in Policy PMP1 of the Core Planning Strategy Development Plan Document (DPD) (December 2009), is the provision of 345 additional homes per year for the period up to 2016-17. However, since the adoption of the Core Planning Strategy, the Mayor has produced the draft Replacement London Plan which introduces a new Borough target to provide a minimum of 2,100 additional new homes between 2011 and 2021 (210 units per annum). Accordingly, the following revised minimum housing targets set out in Table 3-6 have been included in Sutton's Site Development Policies DPD Proposed Submission document[8] published in March 2011.

Table 3-6 Revised Minimum Housing Targets for LB Sutton 2009-2024

Delivery Period of CPS	Housing Targets
2009-10 *(1 year)*	345
2010-11*(2 year)*	345
2011-12 to 2015-16 *(5 years)*	1,050 (Five-Year Supply – 5 x 210)
2016-17 to 2020-21 *(5 years)*	1,050
2021-22 to 2023-24 *(3 years)*	630
Total over 15 years	3,420

3.9.7 The distribution of new dwellings over this period will be broadly as follows

- Sutton Town Centre 40% (1368 units);
- Hackbridge 20% (684 units);
- Wallington 10% (342 units);
- Other District Centres (Rosehill, North Cheam, Worcester Park, Carshalton and Cheam) 10%; (342 units); and,
- Remainder of the Borough 20% (684 units)

[8] 'Additional Sutton Town Centre and Updated Climate Change Policies and Proposals' (March 2011) – see http://www.sutton.gov.uk/CHttpHandler.ashx?id=14088&p=0

3.9.8 Land available for development is scarce within the Borough and is being put under increasing pressure due to the demand for new housing. It is essential that decisions are made through the spatial planning process which can guarantee that land is used efficiently. However, it is also essential that the impact of future development on existing infrastructure, including the drainage systems, is assessed and adequately managed.

3.9.9 Findings from the SWMP thus far identify that Hackbridge is at significant risk of flooding from pluvial and groundwater sources in addition to the risk posed by the River Wandle. Given the number of additional residential dwellings proposed for this area, it is important that the risk of surface water flooding is clearly understood in order that measures to mitigate this risk can be adopted.

COMMUNICATE RISK

Professional Stakeholders

3.9.10 There are various professional stakeholders which are in interested in increasing their knowledge of risks from surface water flooding. It is essential that the SWMP partnership actively engages with these groups, where appropriate, to share the findings of this report. This will ensure that emerging plans and policies are informed by the latest and improved understanding of surface water flood risk issues.

4.1.3 Appendix G – Spatial Planning Information Pack and Appendix H – Resilience Forum and Emergency Planner Information Pack provide guidance on how the SWMP outputs should be used in updating existing planning documents, such as Strategic Flood Risk Assessments (SFRAs) and Multi-Agency Flood Plans (MAFPs), and informing emerging planning policy and spatial planning decisions.

Local Resilience Forums

3.9.11 In line with the Defra SWMP Technical Guidance it is strongly recommended that the information provided in the SWMP is issued to the Local Resilience Forum. Surface water flood maps and knowledge of historic flood events should be used to update Incident Management Plans and Community Risk Registers for the area. In addition, maps showing the depth of pluvial flooding during a range of return period rainfall events can be used to inform operations undertaken by emergency response teams especially near public buildings and major routes through the Borough. This information can be used in parallel with Extreme Rainfall Alert (ERA) service provided by the Flood Forecasting Centre[9]. In addition, maps showing the depth of pluvial flooding during a range of return period rainfall events can be used to inform operations undertaken by emergency response teams especially near public buildings and major routes through the Borough.

Communication and Engagement Plan

3.9.12 It is recommended that a Communication and Engagement Plan should be produced for the London Borough of Sutton to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public.

3.9.13 Local Government Group guidance highlights the following issues when considering preparation of a Communication Plan:

[9] The Flood Forecasting Centre was set up in 2008 by the Met Office and the Environment Agency to provide services to emergency and professional partners.

- Ensuring communities have enough information to increase their own resilience;
- Addressing past floods and managing future risks, thus adapting to climate change.
- Optimising existing communication activities being delivered by partners potential for joint working
- Making sure that all audiences have a clear understanding of the key messages, how to access the right information, and how communities can take the necessary precautions before, during and after flood events

3.9.14 In light of these recommendations, the Plan should:

- Develop clear key messages from the SWMP (and PFRA) relating to local surface water flood risk and management,
- Create simplified maps and meaningful data for communications materials,
- Clearly define a structure for multi-agency partnership working (based on the partnership structure identified in Phase 1 of the SWMP) and formalise through a Memorandum of Understanding;
- Provide a strategy for communicating the SWMP findings to political stakeholders, local resilience forum members, Regional Flood and Coastal Defence Committee members and the general public and engaging these parties in future local flood risk management actions.

Recommendation 10: Actively engage with professional stakeholders to communicate findings of SWMP and local flood risk management.
Recommendation 11: Issue the SWMP to the Local Resilience Forum and use the SWMP to inform emergency response operations and update Incident Management Plans and Community Risk Registers.
Recommendation 12: Design and gain buy-in to a Communication and Engagement Plan to identify how to effectively communicate and raise awareness of local flood risk to different audiences.

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Table 3-7 Phase 2 Summary of Risk

CDA ID	Scheme Location	Moderation		Infrastructure						Households								Commercial / Industrial				Validation
		Primary	Secondary	Essential		Highly Vulnerable		More Vulnerable		Non-Deprived (All)		Non-Deprived (Basements)		Deprived (All)		Deprived (Basements)		All		Basements Only		
				All	> 0.5m Deep	All	> 0.5m Deep	All	> 0.5m Deep	All	> 0.5m Deep	All	> 0.5m Deep	All	> 0.5m Deep	All	> 0.5m Deep	All	> 0.5m Deep	All	> 0.5m Deep	
Group8_022	Worcester Park/Green Lane	-	-	4	0	1	0	5	0	1915	27	10	0	0	0	0	0	139	0	20	0	Yes - Section 3.8.1
Group8_023	Trafalgar Avenue	-	-	2	0	0	0	3	0	2378	45	0	0	4	0	0	0	102	1	0	0	Yes - Section 3.8.2
Group8_024	Sandy Lane	None	None	0	0	0	0	0	0	308	1	0	0	0	0	0	0	2	2	0	0	Yes - Section 3.8.3
Group8_025	York Rd/Mulgrave Rd	None	None	0	0	0	0	1	0	476	16	0	0	0	0	0	0	3	0	0	0	Yes - Section 3.8.4
Group8_026	Sutton Junction	Regionally Important Infrastructure	None	7	4	0	0	8	1	2113	43	0	0	0	0	0	0	49	7	0	0	Yes - Section 3.8.5
Group8_027	Carshalton Beeches	None	None	0	0	0	0	6	4	623	49	0	0	0	0	0	0	29	25	0	0	Yes - Section 3.8.6
Group8_028	Carshalton Centre	Regionally Important Infrastructure	None	0	0	0	0	6	0	975	32	0	0	0	0	0	0	68	0	0	0	Yes - Section 3.8.7
Group8_029	Beddington Gardens	None	None	0	0	0	0	1	0	548	26	0	0	0	0	0	0	8	0	0	0	Yes - Section 3.8.8
Group8_030	Wallington Rail Bridge	-	-	0	0	0	0	2	0	84	5	0	0	0	0	0	0	73	1	0	0	Yes - Section 3.8.9
Group8_031	South Beddington	None	None	0	0	1	0	1	0	571	9	0	0	0	0	0	0	52	0	0	0	Yes - Section 3.8.10
Group8_032	Beddington Park	-	-	0	0	0	0	2	0	377	27	0	0	0	0	0	0	10	0	0	0	Yes - Section 3.8.11
Group8_033	Hackbridge	-	-	1	0	0	0	2	0	1023	11	0	0	0	0	0	0	68	1	0	0	Yes - Section 3.8.12

Notes

The Summary of Risk table is populated by calculating the total number of units from each sub-category that are affected by surface water flooding in the modelled scenario for the 1% AEP rainfall event. In accordance with the Drain London Data and Modelling Framework, the Environment Agency National Receptor Database (NRD) Version 1.0 has been used to identify receptors at risk of flooding within each CDA. The type of receptor has been identified based on definitions (MCM Codes) within Appendix 3.1 of the Multi-Coloured Manual[10] and divided into sub-categories consistent with those within Planning Policy Statement 25: Development and Flood Risk[11]. A summary is provided in the following tables:

Infrastructure Sub-Categories	
Category	**Description**
Essential Infrastructure	• Essential transport infrastructure which has to cross the area at risk • Mass evacuation routes • Tube stations and entrances • Essential utility infrastructure which has to be located in a flood risk area for operation reasons • Electricity generating power stations and grid and primary substations • Water treatment works
Highly Vulnerable	• Police stations, Ambulance stations, Fire stations, Command Centres and telecommunications installations • Emergency disposal points • Installations requiring hazardous substances consent
More Vulnerable	• Hospitals • Health Services • Education establishments, nurseries • Landfill, waste treatment and waste management facilities for hazardous waste • Sewage treatment works • Prisons

Household & Basement Sub-Categories	
Category	**Description**
Households	• All residential dwellings • Caravans, mobile homes and park homes intended for permanent residential use • Student halls of residence, residential care homes, children's homes, social services homes and hostels
Deprived Households	• Those households falling into the lowest 20% of ranks by the Office of National Statistics' Indices of Multiple Deprivation.
Non-Deprived Households	• Those households not falling into the lowest 20% of ranks by the Office of National Statistics' Indices of Multiple Deprivation
Basements	• All basement properties, dwellings and vulnerable below ground structures (where identified in existing dataset including those provided by Thames Water and the Environment Agency's National Receptor Database).

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

[11] DCLG (Revised 2010) Planning Policy Statement 25: Development & Flood Risk

4. Phase 3: Options

4.1 OBJECTIVES

4.1.1 The purpose of Phase 3 is to identify a range of structural and non-structural measures for alleviating flood risk and assess them to eliminate those that are not feasible or cost beneficial. The remaining options are then developed and tested against their relative effectiveness, benefits and costs.

4.1.2 To maintain continuity within the report and to reflect the flooding mechanisms within the Borough the option identification has taken place on an area-by-area (site-by-site) basis following the process established in Phase 2. Therefore, the options assessment undertaken as part of the SWMP assesses and short-lists the measures for each CDA and identifies any non-standard measures available.

4.1.3 Phase 3 delivers a high level option assessment for each of the Critical Drainage Areas (CDAs) identified in Phase 2. No monetised damages have been calculated and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. Costs should be treated at an order of magnitude level of accuracy. The options assessment presented here follows that described in the Defra SWMP Guidance but is focussed on highlighting areas for further detailed analysis and immediate 'quick win' actions. Further detailed analysis may occur for high priority Critical Drainage Areas as defined by the London-wide Prioritisation Matrix within the next Tier (Tier 3) of the Drain London project.

4.2 METHODOLOGY

IDENTIFY MEASURES

4.2.1 This stage aims to identify a number of measures that have the potential to alleviate surface water flooding in the London Borough of Sutton. It has been informed by the knowledge gained as part of the Phase 1 and Phase 2 work. Where possible options will be identified that have multiple benefits, for example to alleviate flooding from more than one source, or provide environmental benefits such as water quality, biodiversity and amenity benefits. At this stage the option identification pays no attention to constraints such as funding or delivery mechanisms to enable a robust assessment.

4.2.2 As detailed in the Defra SWMP Guidance, measures have been identified regardless of the potential mechanism or funding. A standard set of structural and non-structural measures have been specified by the Drain London Forum for consideration within each CDA (Table 4-1) and follow the source-pathway-receptor model. Structural measures are considered to be those which require fixed or permanent assets to mitigate flood risks. Non-structural measures are those which are responses to urban flood risk that may not involve fixed or permanent facilities, and whose positive contribution to the reduction of flood risk is most likely through a process of influencing behaviour.

Table 4-1: Drain London Structural and Non-Structural Measures for Consideration

Source	Pathway	Receptor
Green roof	Increasing capacity in drainage systems	Improved weather warning
Soakaways	Separation of foul and surface water sewers	Planning policies to influence development
Swales	Improved maintenance regimes	Temporary or demountable flood defences
Permeable Paving	Managing overland flows	Social change, education and awareness
Rainwater Harvesting	Land management practices	Improved resilience and resistance measures
Detention Basins	Making Space for Water	

4.2.3 An opportunity assessment was undertaken for each CDA to evaluate where there were opportunities for the implementation of structural and non-structural measures identified by the Drain London Forum and through consultation with relevant stakeholders. The results from the Opportunity Assessment for each CDA are summarised in Table 4-2. Full details are included in Appendix E.

Table 4-2: Measures Opportunity Assessment

CDA ID	CDA Name	Source								Pathway								Receptor					
		Green Roof	Soakaways	Swales	Permeable Paving	Rainwater Harvesting	Detention Basins	Ponds and Wetlands	Other 'Source' Measures	Increasing Capacity in Drainage Systems	Separation of Foul and Surface Water Sewers	Improved Maintenance Regimes	Managing Overland Flows (Online Storage)	Managing Overland Flows (Preferential Flow paths)	Land Management Practices	Deculverting Watercourse(s)	Other 'Pathway' Measures	Improved Weather Warning	Planning Policies to Influence Development	Temporary or Demountable Flood Defences	Social Change, Education and Awareness	Improved Resilience and Resistance Measures	Other 'Receptor' Measures
Group8_022	Worcester Park	×	×	✓	✓	✓	✓	✓		✓		✓	✓	✓	×	×		✓	✓	✓	✓	✓	
Group8_023	Trafalgar Avenue	×	×	✓	✓	✓	✓	×		✓		✓	✓	✓	×	×		✓	✓	✓	✓	✓	
Group8_024	Sandy Lane	×	✓	✓	✓	✓	✓	✓		✓		✓	×	✓	×			✓	✓	✓	✓	✓	
Group8_025	York & Mulgrave Rd	×	✓	×	✓	✓	×	×		✓		✓	✓	✓	×			✓	✓	✓	✓	✓	
Group8_026	Sutton Junction	✓	✓	✓	✓	✓	✓	×		✓		✓	✓	✓	×			✓	✓	✓	✓	✓	
Group8_027	Carshalton Beeches	×	✓	✓	✓	✓	✓	×		✓		✓	✓	✓	×			✓	✓	✓	✓	✓	
Group8_028	Carshalton Centre	×	×	✓	×	✓	✓	×		✓		✓	×	✓	×	×		✓	✓	✓	✓	✓	
Group8_029	Beddington Gardens	×	✓	×	×	✓	×	×		✓		✓	✓	✓	×			✓	✓	✓	✓	✓	
Group8_030	Wallington Rail Bridge	*Scheme currently under implementation.*																					
Group8_031	South Beddington	×	✓	×	×	✓	×	×		✓		✓	×	✓	×			✓	✓	✓	✓	✓	
Group8_032	Beddington Park	×	×	✓	×	×	✓	×		✓		✓	✓	✓	✓	×		✓	✓	✓	✓	✓	
Group8_033	Hackbridge	✓	×	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	

Measures Opportunity Assessment Criteria	
✓	There are opportunities for implementation of this mitigation measure within the CDA. Measure should be considered in the Options Assessment.
✓	There may be some, but limited opportunities for implementation of this mitigation measure within the CDA. Measures should be considered in the Options Assessment but would likely be limited in effectiveness or be subject to site-specific investigations prior to consideration.
×	There are no opportunities for implementation of measure within CDA. The measure it not suitable or required to address the surface water flood risk within the CDA.
	Not Applicable

Table 4-3 Identification of Potential Options

Description		Standard Measures Considered
Do Nothing	Make no intervention / maintenance	• None
Do Minimum	Continue existing maintenance regime	• None
Improved Maintenance	Improve existing maintenance regimes e.g. target improved maintenance to critical points in the system.	• Improved Maintenance Regimes
Planning Policy	Use development control policies to direct development away from areas of surface water flood risk or implement flood risk reduction/resilience measures.	• Planning Policies to Influence Development
Source Control, Attenuation and SuDS	Source control methods aimed to reduce the rate and volume of surface water runoff through infiltration or storage, and therefore reduce the impact on receiving drainage systems.	• Green Roof • Soakaways • Swales • Permeable paving • Rainwater harvesting • Detention Basins, Ponds and Wetlands • Land Management Practices
Flood Storage / Permeability	Large-scale SuDS that have the potential to control the volume of surface water runoff entering the urban area, typically making use of large areas of green space. Upstream flood storage areas can reduce flows along major overland flow paths by attenuating excess water upstream.	• Detention Basins • Ponds and Wetlands • Managing Overland Flows (Online Storage) • Land Management Practices
Separate Surface Water and Foul Water Sewer Systems	Where the CDA is served by a combined drainage network separation of the surface water from the combined system should be considered. In growth areas separation creates capacity for new connections.	• Separation of Foul and Surface Water Sewers
De-culvert / Increase Conveyance	De-culverting of watercourses and improving in-stream conveyance of water.	• Deculverting Watercourse(s)
Preferential / Designated Overland Flow Routes	Managing overland flow routes through the urban environment to improve conveyance and routing water to watercourses or storage locations. E.g. creation of play areas designed to flood, see 'Blue Space Toolkit' prepared on behalf of Sutton Council by BACA Architects.	• Managing Overland Flows (Preferential Flowpaths) • Temporary or Demountable Flood Defences
Community Resilience	Improve community resilience and resistance of existing and new buildings to reduce damages from flooding, through, predominantly, non-structural measures. See 'Blue Space Toolkit' prepared on behalf of Sutton Council by BACA Architects.	• Improved Weather Warning • Temporary or Demountable Flood Defences • Social Change, Education and Awareness • Improved Resilience and Resistance Measures
Infrastructure Resilience	Improve resilience of critical infrastructure in the CDA that is likely to be impacted by surface water flooding e.g. electricity substations, pump houses.	• Improved Resilience and Resistance Measures
Other - Improvement to Drainage Infrastructure	Add storage to, or increase the capacity of, underground sewers and drains and improving the efficiency or number of road gullies.	• Increasing Capacity in Drainage Systems
Other or Combination of Above	Alternative options that do not fit into above categories or combinations of the above options where it is considered that multiple options would be required.	

IDENTIFY & SHORTLIST OPTIONS

4.2.4 Following the identification of measures that should be considered within the Borough, options have been identified and shortlisted for each CDA. As a detailed appraisal of cost and benefits of each of the measures is not deemed to be practical, a high-level scoring system for each of the options has been developed. The approach to short-listing the measures is based on the guidance in FCERM[12] and Defra's SWMP technical guidance[13]. The scoring criteria are provided in Table 4-4.

Table 4-4: Options Assessment Short-Listing Criteria

Criteria	Description	Score
Technical	• Is it technically possible and buildable? • Will it be robust and reliable? • Would it require the development of a new technique for its implementation?	U: Unacceptable (measure eliminated from further consideration) -2: Severe negative outcome -1: Moderate negative outcome 0: Neutral +1: Moderate positive outcome +2: High positive outcome
Economic	• Will benefits exceed costs? • Is the measure within the available budget? • Estimate the whole life costs of the option including asset replacement, operation and maintenance. The scoring of this measure will depend on the budget available from the local authority although it should be remembered that alternative routes of funding could be available such as Thames Region Flood Defence Committee.	
Social	• Will the community benefit or suffer from implementation of the measure? • Does the option promote social cohesion or provide an improved access to recreation/open space? • Does the option result in opposition from local communities for example if an option involves the displacement of houses?	
Environmental	• Will the environment benefit or suffer from implementation of the measure? • Would the option have a positive or negative effect on the environment for example, water quality and biodiversity?	
Objectives	• Will it help to achieve the objectives of the SWMP partnership? • Does the option meet the overall objective of alleviating flood risk?	

4.2.5 London Borough of Sutton has already implemented options within several of the CDAs that have been identified and works are currently underway in several others. Meetings were held with London Borough of Sutton in March 2011 to discuss and agree short-listed options identified for each CDA and to discuss works currently in progress.

4.2.6 The process aimed to ensure that inappropriate measures are eliminated early in the process to avoid investigation of options that are not acceptable to stakeholders. The agreed shortlisted options have been progressed to the Preferred Options stage where they will be costed and further developed.

[12] Environment Agency (March 2010) *'Flood and Coastal Erosion Flood Risk Management Appraisal Guidance'*, Environment Agency: Bristol.

[13] Defra (March 2010) *'Surface water management plan technical guidance'*, Defra: London

4.3 PREFERRED OPTIONS

BOROUGH WIDE– PREFERRED OPTIONS

4.3.1 A number of options and policies have been identified that the Council and relevant stakeholders may consider adopting as part of their responsibility as LLFA for local flood risk management. The preferred Borough-wide options are listed below and described in more detail in the following sections.

- Raising Community Awareness
- Improving Resilience to Flooding
- Ongoing improvements to Maintenance of Drainage Network.
- Planning and Development Policies.
- Water Conservation.

Borough Wide Options: Raising Community Awareness (Policy Areas 3 & 4)

4.3.2 A 'quick win' action that could be implemented in the short-term is to increase awareness of flooding within communities at risk, and across both Policy Areas. This could be achieved through a number of measures including:

- Newsletters;
- Drop-in surgeries;
- Promotion on Sutton Council's website (see Figure 4-1); and
- Community Flood Plans.

4.3.3 The aim of these actions is to raise awareness and improve understanding of the risks and consequences of surface water flooding amongst local communities and, through this, encourage residents to take up measures to combat flooding. Such measures may include installation of water butts to capture roof runoff and consideration of the extent and materials used when replacing permeable areas within hard standing areas within their property e.g. through the installation of driveways and patios.

Figure 4-1 – Example Newsletter (URS Scott Wilson, 2011)

Recommendation 13: Consider and implement options for raising community awareness including letter drop, public meetings, and/or preparation of Community Flood Plans.	
Option A	Undertake a letter drop to highlight the improvement works that have been implemented as well as works that are planned for the future.
Option B	A public meeting could be held following the letter drop where residents can highlight any issues. This could include a talk from the key partner organisations – Environment Agency, Thames Water and London Borough of Sutton – on the work that is being undertaken and who is responsible. Such a meeting could also outline how residents can help themselves and highlight their responsibility for maintaining private drainage, soakaways, driveway drainage etc.
Option C	Consider preparing a Community Flood Plan for those communities identified to be at high risk.

Borough Wide Options: Improving Property Level Resilience to Flooding

4.3.4 One method to reduce the risk of surface water flooding to properties is raising property thresholds. Raising the thresholds of entrances to property land, i.e. where there are currently gates adjacent to paved walls, may offer flood resilience benefits.

4.3.5 Thresholds as shown in Figures 4-2 and 4-3 are a useful and accepted method of defending property against flooding. However, this can conflict with possible accessibility issues within Part M, Section 6 of the Building Regulations 2004 and the requirements of the Disability Discrimination Act 1996 (DDA). In Figure 4-3 a brick wall has been constructed across the property driveway in order to protect the property from flooding. Until such time as national guidance or best practice is available London Borough of Sutton will, when required, work with residents to realise suitable, sensible and cost effective solutions which allow access and deliver mitigation against possible flooding.

Figure 4-2 Raised Driveway, Croydon

Figure 4-3 Raised threshold, Coulsdon

4.3.6 In 2010, London Borough of Sutton was awarded with £221k to participate in a national Property Level Flood Protection Scheme. The project was funded by Defra and managed by the Environment Agency, and was aimed at protecting residential properties in a high flood risk area. Following the major Sutton flood event in 2007, 44 properties were protected against future flooding and were located in Beddington Gardens - Wallington, Nightingale Close- Hackbridge and Trafalgar Avenue - Worcester Park.

4.3.7 The grant covered the costs for each property to be surveyed to identify flood protection for doors, air bricks, air vents, pipe work and the external fabric of the structure, as well as

funding for the installation of flood protection measures. Non return valves for foul sewer pipes and surface water pipes were also installed where necessary, puddle sucker pumps were provided to a number of householders, and in cases where non return valves were not used, panseals were provided to residents. Floodguards Systems Limited was awarded the contract in December 2010 and the works were completed by March 2011.

Recommendation 14: Consider opportunities to promote awareness of property level thresholds, particularly in areas of higher flood risk.	
Option A	It is recommended that the Council aim to raise the awareness of the options for increasing property thresholds to protect against flooding.
Option B	It is recommended that the Council work with residents to realise suitable, sensible and cost effective property level resilience to potential flooding (through, for example raising property thresholds to 100mm), particularly in areas where properties are known / identified to be susceptible to surface water flooding.

Borough Wide Options: Ongoing Improvements to Maintenance of Drainage Network

4.3.8 The management and maintenance of the urban drainage network in London Borough of Sutton is the responsibility of a number of organisations:

- London Borough of Sutton – highways drainage including gully pots and soakaway system in the south of the Borough;
- Thames Water – main sewers, lateral sewers;
- Transport for London – highway drainage along the A232, A24 and A217;
- Environment Agency – culverts, raised defences, trash screens, Main River channels;
- Network Rail – railway drainage and culverts beneath raised rail embankments.

4.3.9 Effective cleansing of gully pots is fundamental to the drainage across the Borough (particularly important for more frequent lower magnitude events (<1:30) and London Borough of Sutton operates a regular maintenance regime for gully cleansing, as well as soakaway maintenance in the south of the Borough. Fallen leaves and build up of silt are the main causes of blockages in the highway drainage network. In addition, on highways located on steeper gradients surface water is noted to flow too quickly to enter the gully pots and drain away.

4.3.10 Following the flooding of July 2007, London Borough of Sutton implemented improvements to the drainage system in key locations. A summary is provided in Table 4-5. This is an example of the continued maintenance that must continue to be undertaken across the Borough to ensure the sustained capacity of the drainage system.

Table 4-5 Highway Drainage Improvement Works following July 2007 floods

Location	Critical Drainage Area	Highway Drainage Improvement Works
Tilehurst Road	N/A	Kerbing to deflect floodwater and 3 new drainage catchment chutes
Malden Road	N/A	Drainage alterations to improve catchment
The Glade	CDA_024 Sandy Lane	2 lengths of drainage channel
Ridge Road	CDA_023 Trafalgar Avenue	2 new drainage catchment chutes

Burleigh Road	CDA_023 Trafalgar Avenue	2 new drainage catchment chutes
Camborne Road	CDA_026 Sutton Junction	3 new drainage catchment chutes
Revell Road	N/A	60m of new drainage channel
Chiltern Road	CDA_026 Sutton Junction	Kerb alterations and new drainage catchment chutes at 12 locations
The Highway	CDA_026 Sutton Junction	Kern alterations and new drainage catchment chutes at 8 locations
42 York Road	CDA_025 York Rd / Mulgrave Rd	Bund across driveway to prevent property flooding
Langley Park Road	CDA_026 Sutton Junction	10 new chutes and kerb inlets
Langley Park Road (Cedar Rd to Carshalton Rd)	CDA_026 Sutton Junction	2 new kerb inlets and 8m of new drainage channel
Sutton Court Road	CDA_026 Sutton Junction	Overflow pipe from soakaway to SW sewer
Morland Road	CDA_026 Sutton Junction	5 new drainage catchment chutes
West Way	CDA_027 Carshalton Beeches	Bund across driveway to prevent property flooding
31 Shirley Avenue	CDA_024 Sandy Lane	New drainage catchment chute
South Avenue		New drainage catchment chute
31 Woodmansterne Road	CDA_027 Carshalton Beeches	10m of new drainage pipe out falling to pond
West Street Junction Festival Walk		Bund across driveway to prevent property flooding
201 Banstead Road	CDA_027 Carshalton Beeches CDA_028 Carshalton Centre	27m of drainage pipe out falling to River Wandle re-laid
104 The Causeway	CDA_033 Hackbridge	20 sq m of flood damaged carriageway
2 Downside Road		Bund across driveway to prevent property flooding
Brookfield Avenue Junc Wrythe Lane	CDA_033 Hackbridge	Flood alleviation scheme comprising bund and ditch
London Road Junc Riverside Close	CDA_033 Hackbridge	Bund across driveway to prevent property flooding
Derek Avenue		4 new drainage chutes
59 Boundary Road	CDA_029 Beddington Gardens	3 new drainage catchment chutes
Wallington Station	CDA_030 Wallington Railway Bridge	Decanting of soakaways under the railway bridge following severe events to ensure they work to their full potential
Boundary Road Junc Hawthorne/Brambledown/Heathdene	CDA_029 Beddington Gardens	New drainage catchment chute
Park Hill Road Junc Hall Road		Kerbing to deflect floodwater and 3 new drainage catchment chutes

4.3.11 Additional options that could be considered by London Borough of Sutton with respect to highway drainage maintenance include:

Recommendation 15: Consider opportunities for ongoing improvements to the maintenance of the drainage network.	
Option A	Gullies that are known to flood could be painted yellow to encourage residents to check if they are blocked and to avoid parking directly over them thereby preventing access for gully clearing team.
Option B	Encourage gully cleansing contractors to use powers to enforce movement of parked cars to ensure all gullies are regularly cleared.
Option C	Coordinate timing of gully cleansing rounds to ensure that they do not coincide with school opening and closing times and other peak times that would prevent gaining access to gullies.
Option D	Focus attention on the maintenance of gully pots in the identified Critical Drainage Areas (CDAs) which are considered to be high risk.
Option E	Develop a GIS database of all Council-owned flood / drainage assets (in line with FWMA requirements).
Option F	As LLFA, the Council must record and investigate incidents of flooding. It is recommended that the source of flooding be recorded, e.g. gully surcharging, to inform maintenance priorities.

Borough Wide Options: Planning & Development Policies

4.3.12 As part of this phase of work Policy Areas have been defined across the Borough within which appropriate planning policies should be applied to manage flood risk. These Policy Areas cover the entire Borough and are not limited to CDA extents. The reason for the inclusion of these areas is to highlight the fact that even if an area does not fall within a CDA it does not mean that surface water discharge from these areas can be uncontrolled, merely that the need for considering direct options for the area are not so critical. Two Policy Areas have been identified for London Borough of Sutton (Figure 4-4).

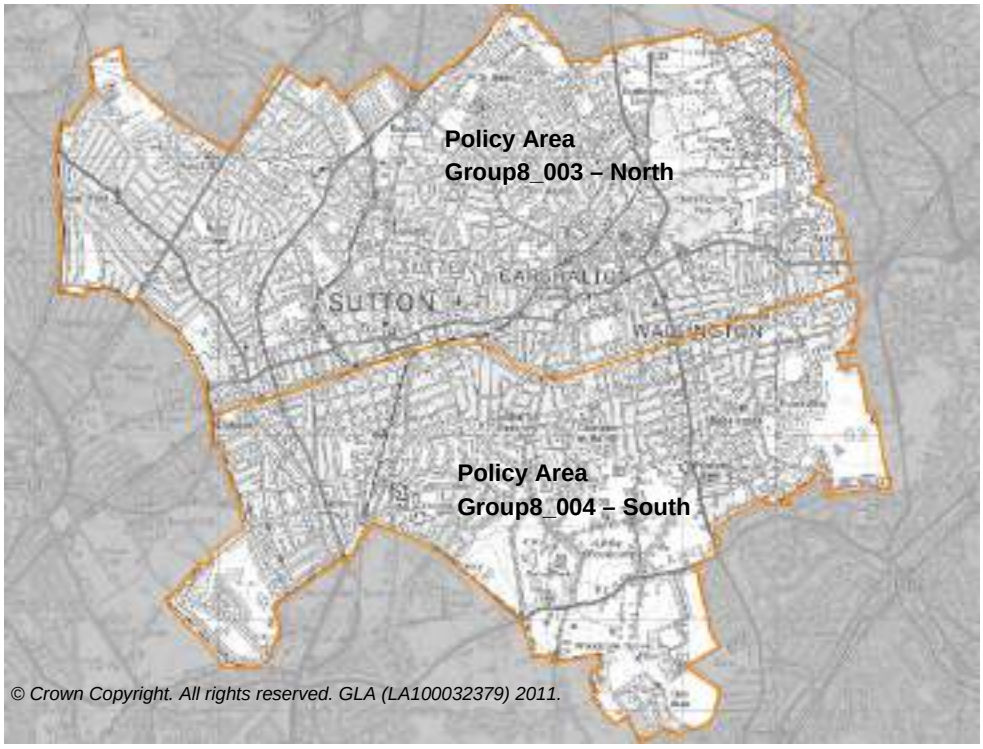


Figure 4-4 London Borough of Sutton Policy Areas

Policy Area Group8_003 – North

4.3.13 London Borough of Sutton is bisected by a railway embankment that runs east-west across the administrative area. The North Policy Area comprises the area of London Borough of Sutton to the north of the railway embankment. This PA contains areas of Environment Agency Flood Zone 3a associated with the River Wandle, Pyl Brook and Beverly Brook and contains the headwaters of the Carshalton Branch of the River Wandle. The PA is characterised by London Clay geology and large parts of the PA have an increased potential for Elevated Groundwater.

4.3.14 More than 60% of the Borough's proposed future development is proposed within the North PA, predominantly within Sutton Town Centre (40%) and Hackbridge (20%).

Policy Area Group8_004 – South

4.3.15 The area to the south of the railway embankment is defined as the South Policy Area. The South PA is characterised by steep land, conducive to overland flow and ponding in topographic depressions, notably behind railway embankments and other barriers to flow. The South PA receives flows from the land to the south and there may be opportunities to liaise with Surrey County Council when developing policies to tackle surface water management within the Borough.

4.3.16 Development is proposed for this PA, but not of the same scale as that in the North PA. There are no Main River fluvial systems within this PA and in stark contrast to the North PA, the underlying geology of the South PA is permeable Chalk.

4.3.17 The rest of this section provides a summary of measures that can be applied through policy. The majority of these measures are common to both Policy Areas; however some will only be relevant to one or other of the Policy Areas.

Paved Gardens

4.3.18 Impermeable paving in gardens can significantly increase surface water runoff entering the local drainage network. From the 1st October 2008 the permitted development rights that allow householders to pave their front garden with hard standing without planning permission was removed. Residents should be encouraged to design their gardens in a way that optimises drainage and reduces runoff. The Council should publicise this issue and refer to standard guidance on the surfacing of front gardens provided by the CLG and Environment Agency in September 2008[14].

[14] Department for Communities and Local Government, 2008, Guidance on the Permeable Surfacing of Front Gardens http://www.communities.gov.uk/documents/planningandbuilding/pdf/pavingfrontgardens.pdf


Figure 4-5 Permeable front gardens allowing for parking

Source CLG/EA Guidance on the permeable surfacing of front gardens 2008 and Richmond Scrutiny Report 2008

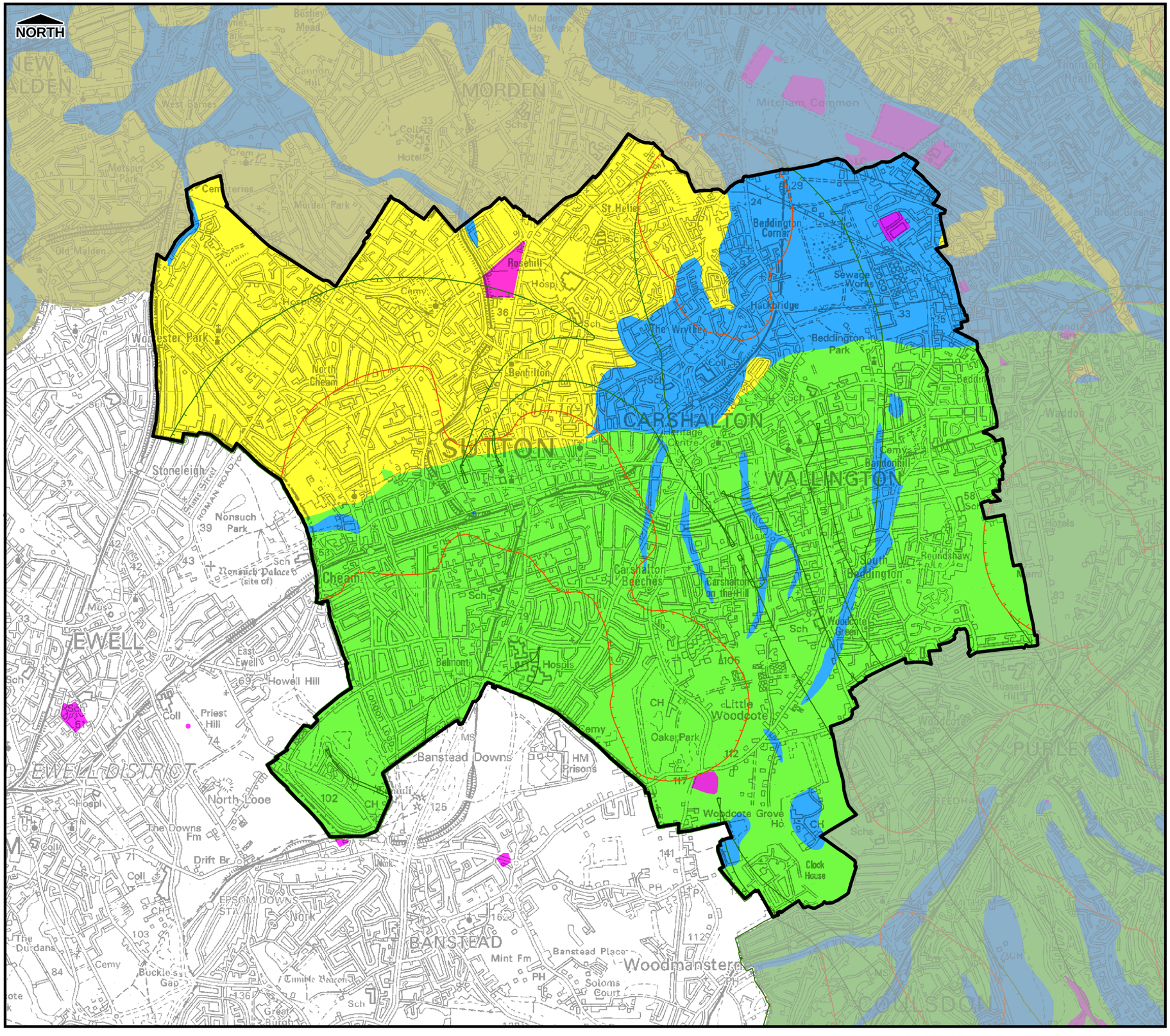
Recommendation 16: Ensure appropriate Development Control Policy for repaving of gardens or driveways and explore education / awareness opportunities for general public regarding SuDS guidance and 'best practice'.	
Option A	The Council could encourage residents to ensure that paved areas in front gardens drain onto flower beds rather than running onto the highway.
Option B	The Council could aim to raise awareness of the options for installation and maintenance of permeable surfaces within property grounds.
Option C	The Council could aim to provide an information portal that residents can consult for further information on permeable paving and other SuDS measures, including links to other organisations (e.g. Environment Agency) who can provide 'best practice' guidance and examples
Option D	The Council could aim to educate/train their staff to ensure that planning officers: • Are aware of the existing planning permissions, guidance and best practice; • Are in a position to educate the public if enquiries are made regarding planning permission to change their drive/garden; and, • Can identify/enforce for non-compliance or non permitted conversion (in particular in CDAs where it exacerbates the problem).

Sustainable Drainage Systems (SuDS)

4.3.19 A number of policies have already been implemented within London Borough of Sutton to ensure that new development incorporates Sustainable Drainage Systems (SuDS) wherever possible. It is recommended that these are reviewed and updated where necessary in the light of the Groundwater Assessment (Appendix C2) and the Infiltration SuDS Suitability Map shown in Figure 4.3.1 and it is likely that this will be done as part of the forthcoming Climate Change Supplementary Planning Document. A summary of the type of SuDS that could be utilised is provided below.

Figure 4.3.1 – Infiltration SuDS Suitability Map

4.3.20 SuDS techniques can be used to reduce the rate and volume and improve the water quality of surface water discharges from sites to the receiving environment (i.e. natural watercourse or public sewer etc). Various SuDS techniques are available and operate on two main principles; attenuation and infiltration. All systems generally fall into one of these two categories, or a combination of the two.



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Sutton Borough Council

EA Groundwater Source Protection Zone

- Inner Zone
- Outer Zone
- Historic Landfill Site

Infiltration SUDS Suitability

- Infiltration SUDS potentially suitable
- Infiltration SUDS potentially unsuitable
- Infiltration SUDS Suitability Uncertain -Site investigation required

Notes

This map forms an approximate guide to Infiltration SUDS Suitability. However, for all new developments, site investigation is required to confirm local geology, depth to groundwater and infiltration rates.

London Borough of Sutton

Surface Water Management Plan

Scale at A3	Date	Drawn by	Approved by
1:40,000	22/03/2011	C.Woolhouse	S.Cox

Infiltration SUDS Suitability Map

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

Environment Agency · Thames Water · London Councils · Greater London Authority

FIGURE 4.3.1

Filepath: D134786 Drain London_Tier 2_Group 8\700 Technical\711 GIS\01 Layout\Sutton\Infiltration SUDS suitability Map.mxd

Infiltration SuDS

4.3.21 This type of Sustainable Drainage System relies on discharges to ground, where ground conditions are suitable. Therefore, infiltration SuDS are reliant on the local ground conditions (i.e. permeability of soils and geology, the groundwater table depth and the importance of underlying aquifers as a potable resource) for their successful operation.

4.3.22 Development pressures and maximisation of the developable area may reduce the area available for infiltration systems. This can be overcome through the use of a combined approach with both attenuation and infiltration techniques e.g. attenuation storage may be provided in the sub-base of a permeable surface, within the chamber of a soakaway or as a pond/water feature.

4.3.23 Permeable surfaces are designed to intercept rainfall and allow water to drain through to a sub-base. The use of a permeable sub-base can be used to temporarily store infiltrated run-off underneath the surface and allows the water to percolate into the underlying soils. Alternatively, stored water within the sub-base may be collected at a low point and discharged from the site at an agreed rate.

4.3.24 Permeable paving prevents runoff during low intensity rainfall, however, during intense rainfall events some runoff may occur from these surfaces.

4.3.25 Programmes should be implemented to ensure that permeable surfaces are kept well maintained to ensure the performance of these systems is not reduced. The use of grit and salt during winter months may adversely affect the drainage potential of certain permeable surfaces.

4.3.26 Types of permeable surfaces include:

- Grass/landscaped areas
- Gravel
- Solid Paving with Void Spaces
- Permeable Pavements

4.3.27 Where permeable surfaces are not a practical option more defined infiltration systems are available. In order to infiltrate the generated run-off to ground, a storage system is provided that allows the infiltration of the stored water into the surrounding ground through both the sides and base of the storage. These systems are constructed below ground and therefore may be advantageous with regards to the developable area of the site. Consideration needs to be given to construction methods, maintenance access and depth to the water table. The provision of large volumes of infiltration/sub-surface storage has potential cost implications. In addition, these systems should not be built within 5m of buildings, beneath roads or in soil that may dissolve or erode.

4.3.28 Various methods for providing infiltration below the ground include:

- Geocellular Systems
- Filter Drain
- Soakaway (Chamber)
- Soakaway (Trench)
- Soakaway (Granular Soakaway)

4.3.29 The infiltration SuDS suitability assessment shown on Figure 4.3.1 is based on minimum permeability data obtained from the BGS. There also exist maximum permeability data,

however, only the minimum permeability is used, as this is understood to be more representative of the bulk permeability.

4.3.30 Three permeability zones have been identified:

1) **Infiltration SuDS potentially suitable:** Minimum permeability is high or very high for bedrock (and superficial deposits if they exist).
2) **Infiltration SuDS potentially unsuitable:** Minimum permeability is low or very low for bedrock (and superficial deposits if they exist).
3) **Infiltration SuDS suitability uncertain:** Minimum permeability is low or very low for bedrock and high or very high for superficial deposits OR minimum permeability is low or very low for superficial deposits and high or very high for bedrock.

4.3.31 Figure 4.3.1 shows that much of Policy Area South is potentially suitable for infiltration SuDS; this is where the unconfined Chalk and Thanet Sand Formation exist. The north west quarter of the London Borough of Sutton area is potentially unsuitable for infiltration SuDS, owing to the outcrop of London Clay Formation. The north east quarter of the Borough requires further investigation, as the ability of the River Terrace Deposits to store and transmit groundwater without causing flooding / drainage issues is uncertain.

4.3.32 It is noted that this is a high level assessment and only forms an approximate guide to infiltration SuDS suitability; a site investigation is required to confirm local conditions.

Attenuation SuDS

4.3.33 If ground conditions are not suitable for infiltration techniques then management of surface water runoff prior to discharge should be undertaken using attenuation techniques. This technique attenuates discharge from a site to reduce flood risk both within and to the surrounding area. It is important to assess the volume of water required to be stored prior to discharge to ensure adequate provision is made for storage. The amount of storage required should be calculated prior to detailed design of the development to ensure that surface water flooding issues are not created within the site.

4.3.34 The rate of discharge from the site should be agreed with the Local Planning Authority and the Environment Agency. If surface water cannot be discharged to a local watercourse then liaison with the Sewer Undertaker should be undertaken to agree rates of discharge and the adoption of the SuDS system.

4.3.35 Large volumes of water may be required to be stored on site. Storage areas may be constructed above or below ground. Depending on the attenuation/storage systems implemented, appropriate maintenance procedures should be implemented to ensure continued performance of the system. On-site storage measures include basins, ponds, and other engineered forms consisting of underground storage.

4.3.36 Basins are areas that have been contoured (or alternatively embanked) to allow for the temporary storage of run-off from a developed site. Basins are designed to drain free of water and remain waterless in dry weather. These may form areas of public open space or recreational areas. Basins also provide areas for treatment of water by settlement of solids in ponded water and the absorption of pollutants by aquatic vegetation or biological activity. The construction of basins uses relatively simple techniques. Local varieties of vegetation should be used wherever possible and should be fully established before the basins are used. Access to the basin should be provided so that inspection and maintenance is not restricted. This may include inspections, regular cutting of grass, annual clearance of aquatic

vegetation and silt removal as required.

4.3.37 Ponds are designed to hold the additional surface water run-off generated by the site during rainfall events. The ponds are designed to control discharge rates by storing the collected run-off and releasing it slowly once the risk of flooding has passed. Ponds can provide wildlife habitats, water features to enhance the urban landscape and, where water quality and flooding risks are acceptable, they can be used for recreation. It may be possible to integrate ponds and wetlands into public areas to create new community ponds. Ponds and wetlands trap silt that may need to be removed periodically. Ideally, the contaminants should be removed at source to prevent silt from reaching the pond or wetland in the first place. In situations where this is not possible, consideration should be given to a small detention basin placed at the inlet to the pond in order to trap and subsequently remove the silt. Depending on the setting of a pond, health and safety issues may be important issues that need to be taken into consideration. The design of the pond can help to minimise any health and safety issues (i.e. shallower margins to the pond reduce the danger of falling in, fenced margins).

4.3.38 Various types of ponds are available for utilising as SuDS measures. These include:

- Balancing/Attenuating Ponds
- Flood Storage Reservoirs
- Lagoons
- Retention Ponds
- Wetlands

4.3.39 Site constraints and limitations such as developable area, economic viability and contamination may require engineered solutions to be implemented. These methods predominantly require the provision of storage beneath the ground surface, which may be advantageous with regards to the developable area of the site but should be used only if methods in the previous section cannot be used. When implementing such approaches, consideration needs to be given to construction methods, maintenance access and to any development that takes place over the storage facility. The provision of large volumes of storage underground also has potential cost implications.

4.3.40 Methods for providing alternative attenuation include:

- Deep Shafts
- Geocellular Systems
- Oversized Pipes
- Rainwater Harvesting
- Tanks
- Green and Brown Biodiverse Roofs

4.3.41 In some situations it may be preferable to combine infiltration and attenuation systems to maximise the management of surface water runoff, developable area and green open space.

Water Conservation

4.3.42 Water conservation is a key option for reducing peak discharges and in turn downstream flood risk. This can be applied using a number of options including planning led encouragement of the use of rainfall in rainwater harvesting systems and property level use of water butts. Both are described in more detail below.

Rainwater Harvesting

4.3.43 The potential for the use of rainwater harvesting should be jointly led by Thames Water (for the North Policy Area) and the Council. Promotion of the benefits of such schemes could be rolled out across multiple Boroughs to reduce costs. The principle of rainwater harvesting in both domestic and commercial property is the same. Rainwater from roof areas is passed through a filter and stored within large underground tanks. When water is required, it is delivered from the storage tank to toilets, washing machines and garden taps for use. If the tank becomes low on stored water, demand is topped up from the mains supply. Any excess water can be discharged via an overflow to a soakaway or local drainage network.

4.3.44 Rainwater harvesting systems could be retrofitted to local schools within the Borough. A case study for Southampton University Student Services Building is described below, with an example layout of a system illustrated in Figure 4-6 below[15]:

- Roof Area: 1000m^2
- Underground storage tank: 15,000 litres
- Building occupancy: 150 people
- Planned usage: 21 WCs and 3 urinals
- Expected annual rainwater collection: 410,000 litres
- Capital cost: £4,325
- Expected payback time 5.3 years (based on Southern Water 2006 tariff)

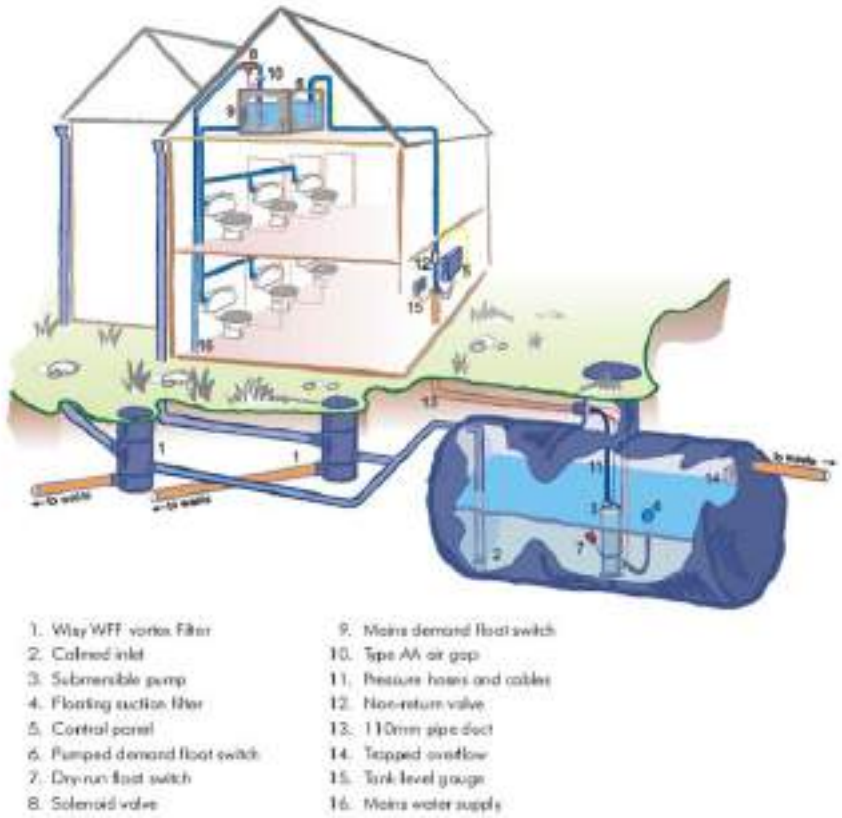


Figure 4-6 Example Rainwater Harvesting system in a Commercial Property

[15] *Source: Rainwaterharvesting systems UK*

Recommendation 17: Consider opportunities to promote rainwater harvesting in both new and existing development throughout the London Borough of Sutton	
Option A	The Council could consider providing an incentive scheme for the use of rainwater harvesting systems across the Borough. This may be linked to the Council's sustainability checklist.
Option B	The Council could consider retrofitting rainwater harvesting systems on Council owned properties, such as schools, for example, which offer educational opportunities as well as local surface water flood mitigation.
Option C	The Council could explore potential opportunities for the installation of rainwater harvesting systems on new or regenerated development areas (in particular where there is high footfall / potential for use).

Water Butts

4.3.45 One of the preferred measures to reduce peak discharges and downstream flood risk, is the robust implementation of water butts on all new development within the Borough, and where possible and higher surface water flooding risk has been identified, retrofitting these to existing properties. Given the constraints associated with infiltration in the north of the Borough, the wholesale implementation of water butts can significantly reduce peak discharges.

4.3.46 Water butts often have limited storage capacity given that when a catchment is in flood, water butts are often full, however it is still considered that they have a role to play in the sustainable use of water and there is potential to provide overflow devices to soakaways or landscaped areas to ensure that there is always a volume of storage available.

4.3.47 Whether to construct formal spill pipes to soakaways, or to allow simple overspill to the adjacent ground are detailed decisions that will need to be based on a site-by-site basis. Such a decision will have only minor significance on the proposals with respect to the surface water drainage.

Rainwater Harvesting – Water Butts		
Description	**Benefits**	**Impacts**
Installation of water butts for all new development within Opportunity Areas	Ties in with SuDS hierarchy and reduces peak discharges to surface water	Positive impacts to sustainability and water re-use.
Retrofit water butts on all existing development (as shown on Figure 4-7)	Supplementary benefits beyond regeneration and redevelopment sites (volumetric reduction with opportunity for complimentary water quality improvements)	Currently no available incentives to encourage homeowners to install water butts.

Figure 4-7 Example of a 100L Water Butt retrofitted to existing development

Recommendation 18: Consider opportunities to promote use of water butts in both new and existing development throughout the London Borough of Sutton	
Option A	Consider installation of water butts for all new development. This ties in with the SuDS hierarchy and reduces peak discharges to surface water and is likely to have positive impacts to sustainability and water re-use
Option B	Consider retrofitting water butts on all existing development. This provides supplementary benefits beyond regeneration and redevelopment sites (volumetric reduction with opportunity for complementary water quality improvements). However there are currently no available incentives to encourage homeowners to install water butts.
Option C	It is recommended that the Council promote the use of water butts across the Borough and provide information on costs, suppliers, installation and benefits.
Option D	Consider installation of water butts for all new development. This ties in with the SuDS hierarchy and reduces peak discharges to surface water and is likely to have positive impacts to sustainability and water re-use

CDA Level Potential Preferred Options

4.3.48 Following the Options Workshop and consultation with relevant stakeholders, potential preferred options (combination of measures) for each CDA have been identified and further assessment to:

- Estimate the benefits; and
- Estimate the approximate implementation costs.

4.3.49 For most CDAs, a range of options have been identified that could be further explored to alleviate flooding. These have been included within the Borough Action Plan as short, medium or long-term actions with an associated priority. However where there is a potential preferred capital scheme for a CDA, this has been identified and the estimated benefits and approximate costs have been assessed for inclusion in a London wide Prioritisation Matrix for consideration by the GLA. A summary of the preferred options is provided within Table 4-6 and further described in the following sections.

Benefits

4.3.50 For the purpose of the Drain London Prioritisation Matrix, it is necessary to determine the benefits of each preferred option. The potential benefits of the scheme are measured using

an estimated percentage of units removed from the predicted floodplain (eliminated) or where flood frequency is reduced (mitigated). This percentage has been determined by calculating the number of units within the Local Flood Risk Zone that the particular scheme has been designed to mitigate, as a percentage of the number of units within the CDA as a whole. The input is restricted to multiples of five percent. It should be noted that the information within this table is purely for input into the Drain London Prioritisation Matrix and should be treated as such. Further modelling would be required to determine more accurately the potential benefits of the suggested schemes.

Costs

4.3.51 An estimated cost for the preferred flood mitigation option for each identified CDA has been calculated based on standard unit costs provided as part of Tier 1 of the Drain London Project to mitigate the 1 in 75 year (3.3% AEP) event. No monetised damages have been calculated, and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. The following standard assumptions have been applied, as determined in the Drain London Prioritisation Matrix Guidance:

- The costs are the capital costs for implementation of the scheme only.
- Costs do not include provisions for consultancy, design, supervision, planning process, permits, environmental assessment or optimum bias.
- No provision is made for weather (e.g. winter working).
- No provision is made for access constraints
- Where required, it will be stated if costs include approximate land acquisition components.
- No operational or maintenance costs are included.
- No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).

4.3.52 As a result, costs have been provided as cost bands[16], reflecting the strategic nature of the SWMP study and options identification.

4.3.53 The following sections provide a summary of potential preferred options for each CDA; full details regarding the justification for preferred and eliminated options is provided in Appendix E.

[16] As defined by Drain London Prioritisation Matrix Guidance, the cost bands to be used are: <£25k, £26k - £50k, £51k - £100k, £101k - £250k, £251k - £500k, £501k - £1m, £1m - £10m and >£10m.

CDA: Group8_022 (Worcester Park)		
Scheme under Implementation: Environment Agency Flood Storage Scheme		
The primary flood source in this area is fluvial flooding from the Beverley Brook. This watercourse is designated Main River and as a result options not within the scope of this SWMP and are primarily the responsibility of the Environment Agency to lead upon. As a result, no preferred option has been put forward for the Prioritisation Matrix for this CDA. An Environment Agency led capital flood alleviation scheme to develop a flood storage area within the Worcester Park Sports Grounds has reportedly been earmarked £1.8m in Local Levy funding and is currently under consultation. The scheme will entail the raising of bank levels, increasing the conveyance of the watercourse and altering the ground levels in the sports ground to provide additional storage. In addition, the channel will be straightened to increase the conveyance capacity of the watercourse.		
Potential Benefits	• Increase conveyance of Beverley Brook; • Provide additional flood storage during high flows; • Providing mitigation for local properties; • Presents educational and community engagement opportunities for local residents / volunteers to learn about existing flood risk and proposed flood storage scheme.	
Preferred Option: 'Quick Win' Measures		
Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage. This option would be particularly beneficial for events of a lower magnitude rather than the high order events.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing and consider the potential to create "cut-ins" along Sandringham Road, Donnington Road and Central Road to create preferential flow paths along the highways and increase the volume of surface water entering the drainage system. Similar measures may also be appropriate for Woodlands Avenue and could therefore be undertaken in liaison with Epsom and Ewell DC and/or Surrey County Council.
Option C	Community Engagement & Emergency Planning	The Council could continue to engage with local residents to inform them of the risk and encourage residents to be pro-active in maintenance of their properties with respect to preparation for flood events, including taking responsibility for property drainage.

CDA: Group8_023 (Trafalgar Avenue / Hamilton Avenue)		
Scheme under Implementation: Property Level Resilience		
The primary flood source in this area is fluvial flooding from the Pyl Brook. This watercourse is designated Main River and as such options are not within the scope of this SWMP and are primarily the responsibility of the Environment Agency. As a result, no options have been put forward for the Prioritisation Matrix for this CDA. London Borough of Sutton has recently provided property level resistance measures for 25 properties on Trafalgar Avenue, comprising the installation of flood gates, non return valves, air brick covers and 'puddle suckers'. London Borough of Sutton was awarded with £221k to participate in the national Property Level Flood Protection Scheme. The project was funded by Defra and managed by the Environment Agency, and was aimed at protecting residential properties in a high flood risk area. Following the major Sutton flood event in 2007, 44 properties were protected against future flooding; the properties were located in Beddington Gardens (CDA029), Nightingale Close (CDA033) and Trafalgar Avenue (CDA023).  **Figure 4-8 Floodguards Property Level Protection; air bricks and non-return valves** The grant covered the costs for each property to be surveyed to identify flood protection for doors, air bricks, air vents, pipe work and the external fabric of the structure, as well as funding for the installation of flood protection measures. Floodguards Systems Limited was awarded the contract in December 2010 and the works were completed by March 2011.		
Preferred Option: 'Quick Win' Measures		
Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage. This option would be particularly beneficial for events of a lower magnitude rather than the high order events.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing and consider the potential for additional works such as the creation of cut-ins in order to improve the efficiency of the connection to the Thames Water network along Henley Avenue and Kingston Avenue. These measures could be implemented as quick win measures as part of London Borough of Sutton's ongoing operational maintenance works.
Option C	Community Engagement & Emergency Planning	The Council could continue to engage with local residents to inform them of the risk and encourage residents to be pro-active in maintenance of their properties with respect to preparation for flood events, including taking responsibility for property drainage.

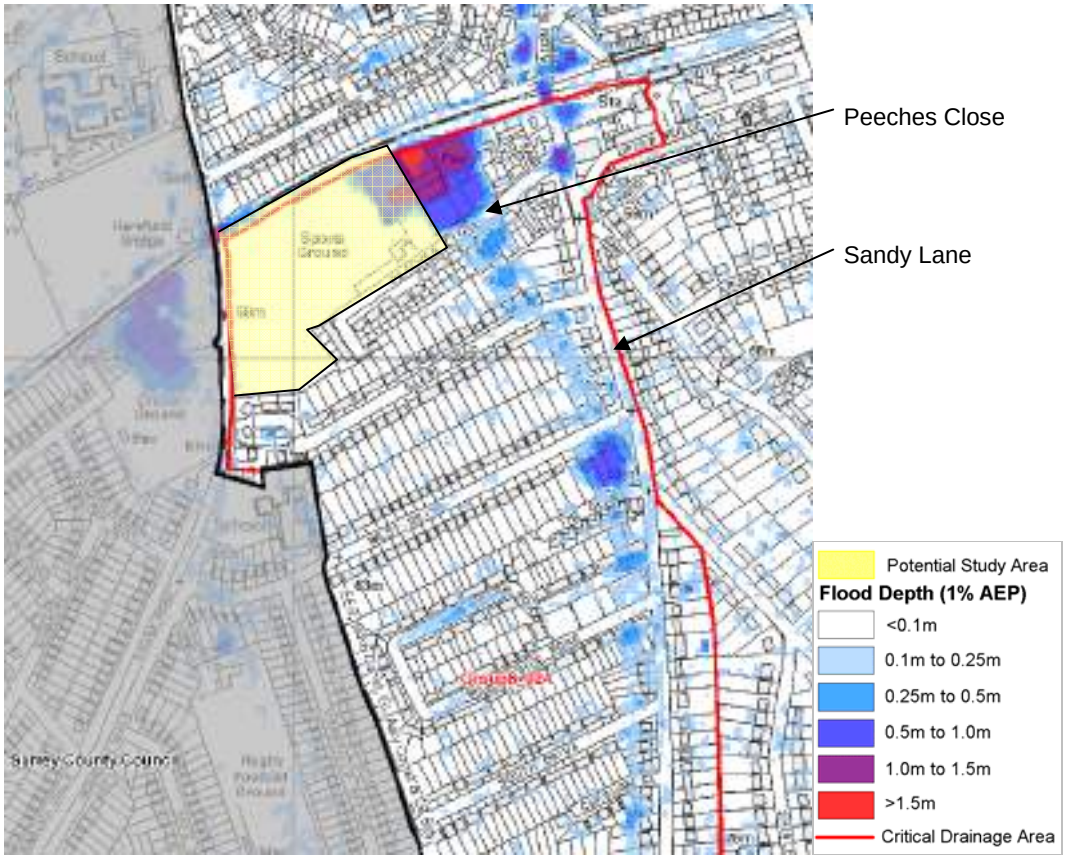
CDA: Group8_024 (Sandy Lane)

Preferred Option: Combined Measures:

- **SuDS – Sandy Lane and Peeches Close**
- **Investigate Flood Storage in Sports Ground**

The Council could consider installing additional soakaways on Sandy Lane and Peeches Close to increase the amount of surface water that is intercepted and enters the drainage system. Soakaways of 3m diameter and 6m depth have been assumed, resulting in a storage volume of approximately 40m^3 per soakaway.

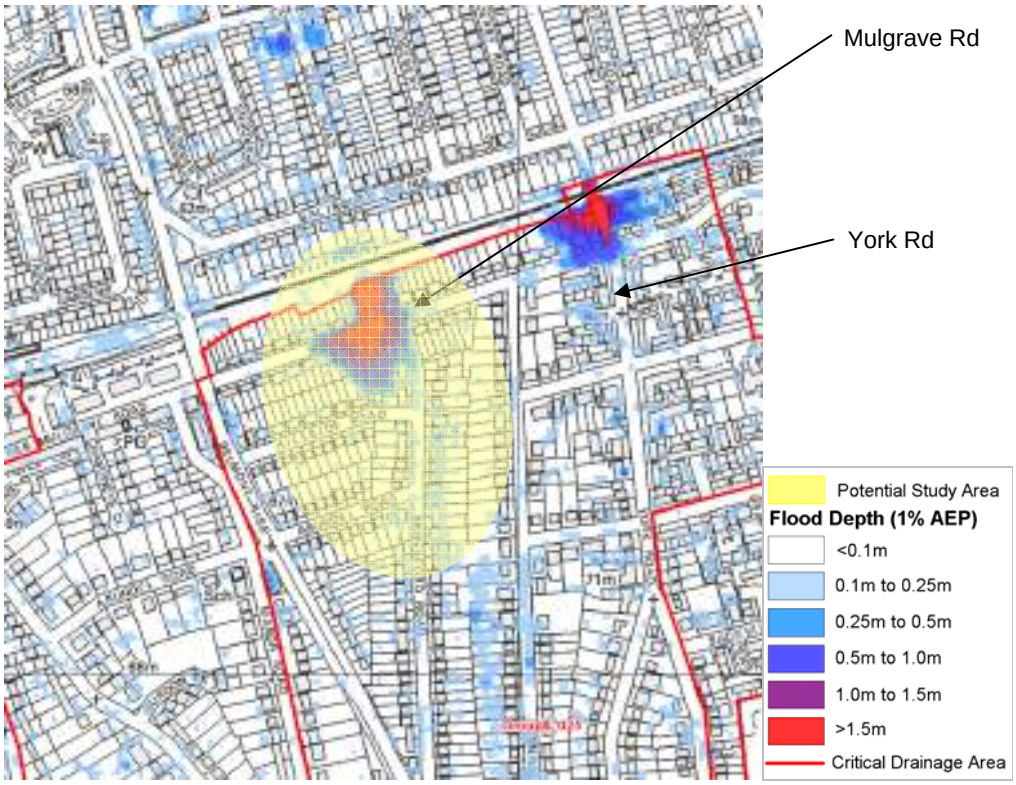
There may be potential to develop a temporary flood storage area in the Sports Ground to the west of the Nuffield Centre of approximate size 5000m^3. Further understanding of the ground levels and flowpaths in this area would help to determine whether this would need to be provided through a drainage tank within the drainage system or an overland storage area. A feasibility study would be required to take this option forward. As part of the preferred option for this CDA, the Council could undertake an assessment of the ground levels and flowpaths in this area to help determine the initial viability of this option.



Approximate Cost	< £25K
Potential Benefits	• The installation of additional soakaways could deliver mitigation of flood risk to 15% of the residential properties and all (100%) of the commercial properties identified to be at risk of flooding in the CDA during the 1% AEP rainfall event.

Additional 'Quick Win' Measures

Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage. This option would be particularly beneficial for events of a lower magnitude rather than the high order events.

CDA: Group8_025 (York Road / Mulgrave Road)	
Preferred Option: Combined Measures: • **Local Drainage Capacity Investigation (Beresford Rd / Mulgrave Rd)** • **SuDS – York Rd / Mulgrave Rd**	
There are two LFRZs located within this CDA; pluvial modelling suggests that overland flow ponds adjacent to the railway embankment on Mulgrave Road and Beresford Road, and underneath the railway crossing on York Road. As part of the preferred option for this CDA, it is recommended that further investigation is made of the existing Thames Water drainage infrastructure and capacity at the crossings underneath the railway embankment including an investigation into the operation of the existing 457mm diameter surface water pipe crossing at the Beresford Road / Mulgrave Road LFRZ. The Council could consider installing additional soakaways on York Road and Mulgrave Road to increase the amount of surface water that is intercepted and enters the drainage system and relieve pressure on the Thames Water network. Soakaways of 3m diameter and 6m depth have been assumed, resulting in a storage volume of approximately 40m^3 per soakaway.  *© Crown Copyright. All rights reserved. GLA (LA100032379) 2011.*	
Approximate Cost	< £25K Capital Schemes <£25K Investigations
Potential Benefits	• Improved understanding of capacity and issues with local drainage network to enable prioritisation for maintenance and upgrades. • The installation of additional soakaways could deliver mitigation of flood risk to 10% of the residential properties identified to be at risk of flooding in the CDA during the 1% AEP rainfall event.

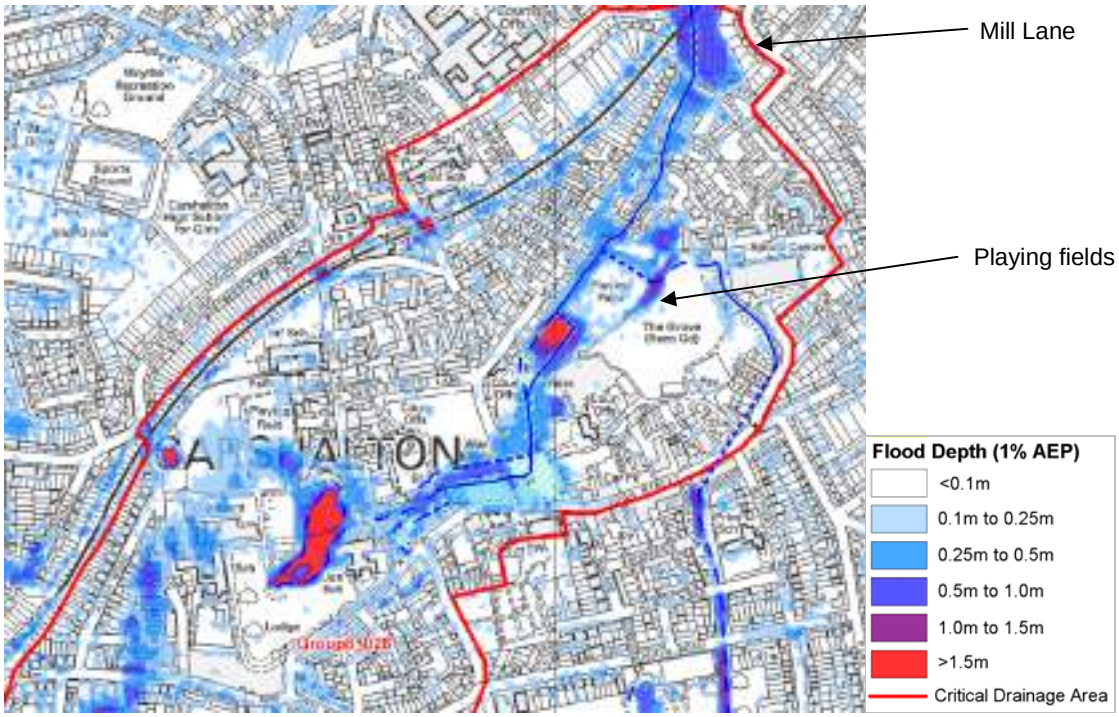
CDA: Group8_026 (Sutton Junction)		
Schemes recently implemented:		
Following the flooding of July 2007, London Borough of Sutton carried out a number of remedial and improvement works within this CDA, including: • 3 new drainage catchment chutes installed on Camborne Road. • 10 new chutes and kerb inlets on Langley Park Road. • 5 new drainage catchment chutes along Morland Road. • Overflow pipe from soakaway to surface water sewer on Sutton Court Road. • Kerb alterations and new drainage catchment chutes at 12 locations along Chiltern Road. • Kerb alterations and new drainage catchment chutes at 8 locations along The Highway.		
Preferred Option: Combined Measures: • **Improvements to Drainage Infrastructure – Cedar Road** • **Investigate feasibility of attenuation measures at Overton Grange School** • **Planning Policy – Belmont (Area of Regeneration)**		
The most critical LFRZ within this CDA is Cedar Road, located at the northern end of the CDA, where flood depths are modelled to exceed 1.5m during the 1% AEP event. The pluvial modelling suggests that there may be cross border flow from Surrey County Council (Reigate and Banstead LPA) into this CDA and therefore there may be opportunities for joint working between LLFAs as part of this option. **Improvements to Drainage Infrastructure – Cedar Road** As part of the preferred option for this CDA, it is recommended that discussions are continued with Thames Water regarding the potential to improve the drainage capacity at Wellesley Road and Cedar Road. There may be potential to remove the 90° bend in the surface water sewer at Cedar Road and install a new length of pipe in order to increase the capacity and efficiency of this sewer and alleviate surcharging of the system. **Investigate feasibility of attenuation measures at Overton Grange School** In addition, the potential to use the open space associated with Overton Grange School playing fields could be investigated further. There may be scope to create a storage area of 28,000m3 and connecting swales, running westwards from the railway line towards the storage area. **Planning Policy – Belmont (Area of Regeneration)** Belmont, located in the south of the CDA, has been identified as an area of regeneration within the Core Planning Strategy. As part of future regeneration, Thames Water should be consulted regarding their role to improve the local system, and the Council to incorporate soakaway drainage where possible.		
Approximate Cost	£501K – 1m	
Potential Benefits	• Improved understanding of flooding mechanisms and risk from Thames Water sewers. • Opportunities to ensure consideration of surface water runoff in any future planning in the Belmont area. • The proposed option is estimated to mitigate the flood risk for an estimated 30% of the commercial properties currently at risk, 10% of residential properties and 70% of the Essential Infrastructure currently identified to be at risk within the whole CDA during the 1% AEP rainfall event.	
Additional 'Quick Win' Measures		
Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage. This option would be particularly beneficial for events of a lower magnitude rather than the high order events.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing.

CDA: Group8_027 (Carshalton Beeches)		
Schemes recently implemented: Improvements to Drainage Infrastructure		
Following the flooding of July 2007, London Borough of Sutton carried out a number of remedial and improvement works within this CDA, including: • Creation of a bund across driveway on West Way to prevent property flooding. • Installation of 10m of new drainage pipe out falling to pond on Woodmansterne Road. • Re-laying of 27m of drainage pipe out falling to the River Wandle on Banstead Road.		
Preferred Option: Combined Measures: • **Improvements to Drainage Infrastructure – Woodmansterne Road** • **SuDS – Barrow Hedges Way and Banstead Road** • **Investigate feasibility of attenuation measures at Barrow Hedges School and Radcliffe Gardens**		
Pluvial modelling shows a defined flowpath through this steep CDA, resulting in significant ponding of floodwaters at Barrow Hedges School and the junction of Banstead Road with Downside Road. In order to alleviate the flooding in this CDA, the preferred option includes measures further up in the catchment to reduce the volume of water flowing through the CDA. The Council could consider undertaking an investigation into the drainage capacity, and condition and position of gullies along the route of Woodmansterne Road which forms a key flowpath within this CDA. If appropriate, the Council may consider installing a length of oversized pipe along Woodmansterne Road and adjacent to Wellfield Gardens, to provide online storage within the drainage system. There may also be scope to attenuate floodwaters in swales, of approximate length 320m, located in the open and landscaped areas around Barrow Hedges School and Radcliffe Gardens. Furthermore, additional gullies and soakaways could be considered for Barrow Hedges Way and Banstead Road which are located along the main flowpath in this CDA.		
Approximate Cost	£51K – 100K	
Potential Benefits	• Potential for improved amenity/multi-functional space in Radcliffe Gardens / Barrow Hedges School • The proposed option is estimated to mitigate the risk of flooding for an estimated 90% of the commercial properties currently at risk, 15% of residential properties and 65% of the More Vulnerable infrastructure currently identified to be at risk within the whole CDA during the 1% AEP rainfall event.	
Additional 'Quick Win' Measures		
Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage. This option would be particularly beneficial for events of a lower magnitude rather than the high order events.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing and consider the potential for additional works to increase the volume of water entering the highway drainage system.
Option C	Preferential Flow Routes	Review kerb heights and driveways and modify where to mitigate property flooding along Beeches Walk, Staplehurst Road, Farmdale Road, Barrow Hedges Way, Fullerton Road, Banstead Road and Downside Road.

CDA: Group8_028 (Carshalton Centre)

Preferred Option: Flood Storage – Playing Fields adjacent to The Grove Recreation Ground

As part of the preferred option for this CDA, the Council could consider the creation of flood storage areas in the playing fields adjacent to The Grove Recreation Ground. There may be potential to create a flood storage area of approximate volume 10,000m^3 with a connecting swale of approximate length 200m running north eastwards from High Street and North Street towards the storage area.



It is noted that the flooding identified in the south of this CDA is influenced by activities in CDA 027 (Carshalton Beeches) and therefore a joined-up approach should be adopted when considering the options for these CDAs.

Approximate Cost	£251K - £500K
Potential Benefits	• Potential for improved amenity/multi-functional space at The Grove Recreation Ground. • Educational and community engagement opportunities for local residents / volunteers to learn about existing flood risk and flood storage scheme. • The proposed option is estimated to mitigate the risk of flooding for an estimated 10% of residential properties currently identified to be at risk within the whole CDA during the 1% AEP rainfall event.

Additional 'Quick Win' Measures

Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing.
Option C	Community Engagement & Emergency Planning	The Council may wish to use the information supplied within this SWMP to inform emergency planning procedures in relation to road closures at Mill Lane during potential flood events.
Option D	Property Level Resilience	Consider property level resistance measures in Bankside Close, Hill Rd, Oxford Road.

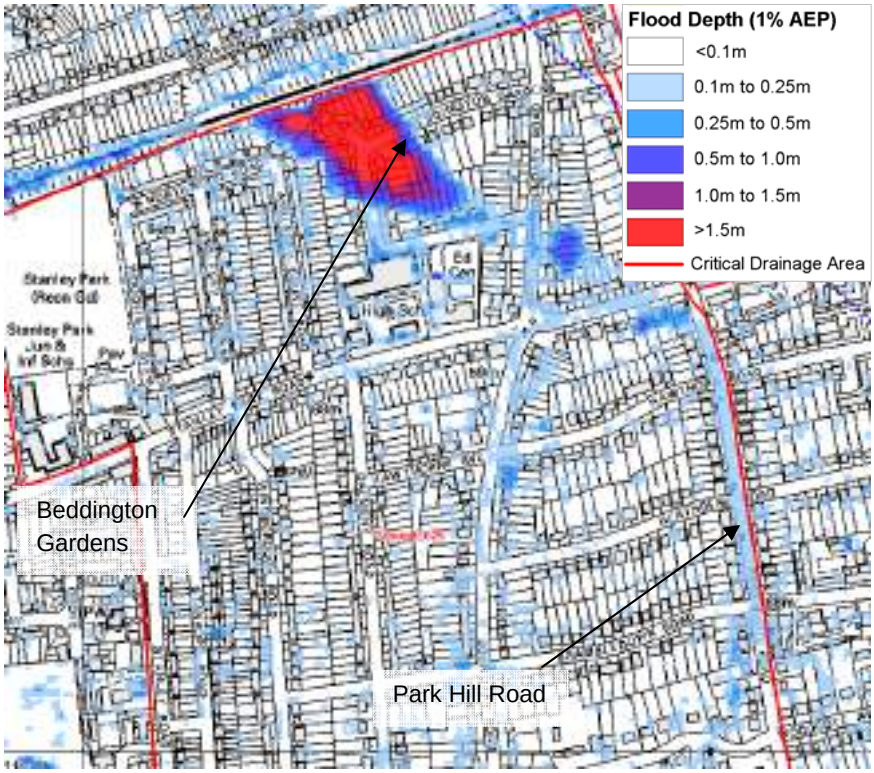
CDA: Group8_029 (Beddington Gardens)

Scheme recently implemented: Property Level Resilience

London Borough of Sutton has recently provided property level resistance measures for 5 properties on Beddington Gardens Avenue, comprising the installation of flood gates and non-return valves and provision of air brick covers and 'puddle suckers'. The project was funded by Defra and managed by the Environment Agency and the Council.

Preferred Option: SuDS

In order to provide additional flood mitigation in this CDA, the only viable and therefore preferred option is the improvement of the existing drainage system through the installation of additional soakaways. The preferred option for this CDA includes the installation of 2 soakaways, of approximate volume 42m^3 each, on Park Hill Road and Beddington Gardens. Further assessment would be required to determine an appropriate capacity for the soakaways at the detailed design stage.



Approximate Cost	<£25K
Potential Benefits	• The proposed option is estimated to mitigate the risk of flooding for residential properties currently identified to be at risk in this area during the 1% AEP rainfall event. Further assessment would be required to determine an appropriate capacity for the soakaways at the detailed design stage.

Additional 'Quick Win' Measures

Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing and consider the potential for additional works to increase the volume of water entering the highway drainage system.

CDA: Group8_030 (Wallington Rail Bridge)		
Scheme under Implementation: SuDS – Wallington Rail Bridge		
London Borough of Sutton is currently implementing a capital scheme to alleviate the flooding underneath the Wallington Rail Bridge and therefore no options identification has been undertaken for this CDA as part of the SWMP. London Borough of Sutton applied to Transport for London under the Local Implementation Plan (LIP) to obtain funding for the works which include the following: • Installation of two new soakaways underneath the railway bridge of depth 8.5m and diameter 3.5m. • Installation of 3 soakaways on Ross Parade, Beddington Gardens, and one to the north of the railway line. • Installation of a valve on the foul sewer to the north of the railway to prevent flow backing up and coming out of the manholes underneath the railway bridge. The scheme is expected to be completed in June 2011.		
Additional 'Quick Win' Measures		
Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage. This option would be particularly beneficial for events of a lower magnitude rather than the high order events.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing and consider the potential for additional works to increase the volume of water entering the highway drainage system.

CDA: Group8_031 (South Beddington)		
Preferred Option: SuDS		
The predominant source of flooding in this CDA is ponding on the highway, and overland flow down Lavender Vale and adjacent adjoining highways. Given the location of the flooding, the only viable and therefore Preferred Option for this CDA is the installation of additional soakaways and associated gully pots along Lavender Vale and Demesne Road to receive the overland flows.		
Approximate Cost	<£25K	
Potential Benefits	• The proposed option is estimated to mitigate the flood risk for the highways, as well as 10% of the residential properties and 15% of the commercial properties currently identified to be at risk within the CDA during the 1% AEP rainfall event.	
Additional 'Quick Win' Measures		
Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage.
Option B	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing along Lavender Vale and Demesne Road.

CDA: Group8_032 (Beddington Park)

Schemes recently implemented: Source Control – Riverside Close

Discussions with the Council drainage engineer highlighted some works which have been completed at Riverside Close where surface water from the highway flowed to the natural low point at Riverside Close. The London Borough of Sutton drainage engineer organised for a bund to be built at the end of Riverside Close (Figure 4-9) and a swale (Figure 4-10) in the kerbside to channel water back to the river. There have been no reports of surface water flooding at this location following the completion of these works.

Figure 4-9 Bund at Riverside Close

Figure 4-10 Swale at Riverside Close

The primary flood source in this area is fluvial flooding from the River Wandle and much of the CDA is located within Flood Zone 3a. The River Wandle is designated Main River and as such options are not within the scope of this SWMP and are primarily the responsibility of the Environment Agency.

Preferred Option: Improvements to Drainage Infrastructure – Wandle Road

The preferred option for this CDA is the installation of an interceptor sewer along Wandle Road of approximate length 250m and diameter 900mm to provide additional storage during times of heavy rainfall and high water levels in the River Wandle.

Approximate Cost	£26K-50K
Potential Benefits	• The proposed option is estimated to mitigate the flood risk for 30% of the residential properties and 10% of the commercial properties currently identified to be at risk within the CDA during the 1% AEP rainfall event.

Additional 'Quick Win' Measures

Option A	Drainage Maintenance	The Council could continue to target highways in this CDA for high priority gully cleansing.
Option B	Land Management	This option could be realised as part of the landscape treatments that have been proposed for Beddington Park as part of the Draft Hackbridge Climate Change Adaptation Action Plan prepared in July 2011. The proposed landscape treatments identified for Beddington Park include shallow hollow areas for water storage which would contribute to reducing surface water runoff entering this CDA.
Option C	Community Engagement & Emergency Planning	The Council could continue to engage with local residents to inform them of the risk and encourage them to consider their responsibilities. The Council may wish to use the information supplied within this SWMP to inform emergency planning procedures.

CDA: Group8_033 (Hackbridge)

Schemes recently implemented: Property Level Resilience

Property Level Resilience Measures

London Borough of Sutton has installed property level resilience measures for 13 properties on Nightingale Close as part of the Defra funded Property Level Flood Protection Scheme.

Planning Policy

It is London Borough of Sutton's vision to see Hackbridge as the UKs first sustainable suburb. In seeking to prepare a Supplementary Planning Document (SPD) to guide the regeneration of Hackbridge, the Council commissioned the preparation of a Draft Hackbridge Masterplan in January 2009 which put forward outline development briefs for key redevelopment sites within the area and provided an evidence base for substantiating the Council's policy approach for promoting sustainable growth and regeneration within Hackbridge as part of the LDF.

Figure 4-11 Floodguards Property Level Protection; Flood Barrier

Preferred Option: Combined Measures:

- **Deculverting Watercourse – Mill Green**
- **Local Drainage Capacity Investigation – Hackbridge**

The primary flood source in this area is fluvial flooding from the River Wandle and a large proportion of the CDA is located within Flood Zone 3a. The River Wandle is designated Main River and as such flood risk management options associated with this watercourse are not within the scope of this SWMP.

However the CDA is also at risk of surface water, sewer and groundwater flooding and a number of measures have been put forward as the combined preferred option for the CDA.

Deculverting Watercourse – Mill Green

The Draft Hackbridge Climate Change Adaptation Action Plan, prepared in July 2011, sets out a number of potential schemes for the Hackbridge area. Proposals include a suite of landscape treatments for Mill Green in the northern part of the CDA including permeable paving, de-culverting the watercourse, creating shallow hollow areas for water storage, as well as creating water meadow grassland and water's edge planting. The preferred option includes a feasibility study for the de-culverting of the watercourse in Mill Green. Other similar landscape treatments are proposed for other parks and open spaces within or adjacent to the Hackbridge area including the New Ecology Park, Watercress Park, Beddington Farmlands, Beddington Park, Poulter Park, Elms Pond and Dale Park which could afford some flood storage and water retention benefits.

Local Drainage Capacity Investigation – Hackbridge

It is recommended that the Council, in partnership with Thames Water investigate the capacity in Thames Water network and consider capital improvements in the network.

Approximate Cost	<£25K for Feasibility Study and <£25K for Investigations
Potential Benefits	• Improved evidence for prioritising localised drainage improvements. • Potential for improved amenity / multi-functional park space within Hackbridge. • Educational and community engagement opportunities for local residents / volunteers to learn about flood risk and management measures.

Additional 'Quick Win' Measures

Option A	Rainwater Harvesting	The widespread installation of water butts for properties within this CDA could provide a significant volume of rainwater storage.
Option B	Drainage Maintenance	The Council could continue to target highways for priority cleansing.

4.4 Preferred Options Summary

4.4.1 A summary of the preferred options (capital schemes) discussed above is presented in Table 4-6.

4.5 Recommendations for Next Steps & Quick Wins

4.5.1 Taking into account the nature of the surface water flooding in the London Borough of Sutton, the options identified through the Phase 3 Options Assessment, and requirements under the FWMA and FRR2009, it is considered that the London Borough of Sutton should prioritise the following actions in the short to medium-term:

Recommendation 19: Identify and record surface water assets as part of the London Borough of Sutton Asset Register, prioritising those areas that are known to regularly flood and are therefore likely to require maintenance or upgrading in the short-term.

Recommendation 20: Consider the development of an 'Information Portal' via the London Borough of Sutton website, including links to the relevant Environment Agency and National Flood Forum web pages that provide advice on measures that can be taken by residents to mitigate surface water flooding to / around their property. This could be developed in conjunction with the South West London Strategic Flood Group and include:

- A list of appropriate property-level flood risk resilience measures that could be installed in a property;
- A link to websites / information sources providing further information, such as the Environment Agency and National Flood Forum; and
- An update on work being undertaken in the Borough by the Council and/or other Stakeholders to address surface water flood risk.

Recommendation 21: Prepare a Communication Plan to effectively communicate and raise awareness of surface water flood risk to different audiences using a clearly defined process for internal and external communication with stakeholders and the public.

Recommendation 22: In conjunction with Thames Water, determine the capacity of the existing sewer network along Cedar Road (CDA_026 Sutton Junction) and continue to discuss options for increasing the surface water sewer capacity at this location.

Recommendation 23: In partnership with Thames Water, undertake a Drainage Capacity Study for the Hackbridge and South Beddington area (CDA_033, CDA_031), to determine the drainage capacity. The study could consider the following:

- Identifying and recording surface water assets, including type, location and condition, as required for preparation of the Asset Register;
- Determine the condition and capacity of gullies and carrier pipes;
- Determining the connections to Thames Water surface sewers and assets;
- Undertaking CCTV surveys of those areas which experience regular surcharging and flooding;
- Clearing those gullies or pipes identified as blocked during investigations (as part of annual maintenance routine); and,
- Determining upgrade requirements and costs for the local drainage infrastructure and seek funding opportunities to implement these.

Recommendation 24: Consider undertaking a feasibility study to assess the potential for flood storage in Overton Grange School Playing Fields (CDA_026 Sutton Junction).
Recommendation 25: Consider undertaking a feasibility study to assess the potential for flood storage in The Grove Recreation Ground (CDA_028 Carshalton Centre).
Recommendation 26: Consider undertaking a feasibility study to assess the potential to de-culverting the watercourse in Mill Green, as identified in the Draft Hackbridge Climate Change Adaptation Plan (CDA_033 Hackbridge).
Recommendation 27: Use the findings of the SWMP to review the priority areas that are currently targeted for gully cleansing and maintenance and amend if necessary.

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Table 4-6 Phase 3 Summary of Preferred Options

CDA_ID	CDA Name	Option Category	Option Description	Combination Scheme?	Indicative Dimensions & Costs (See Notes below)										
					Measures	Cost (£) per Unit	Unit Description	Unit	Length	Area	Depth	Volume	Number	Drain London Cost Band	Cost Band for Combination Scheme
Group8_022	Worcester Park	None (schemes already identified)	None	N/A		N/A	N/A	N/A						N/A	-
Group8_023	Trafalgar Ave	None	None	N/A		N/A	N/A	N/A						N/A	-
Group8_024	Sandy Lane	Source Control, Attenuation and SuDS	Soakaway on Sandy Lane	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	<£25k
		Source Control, Attenuation and SuDS	Soakaway on Peeches Close	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	
Group8_025	York & Mulgrave Rd	Source Control, Attenuation and SuDS	Soakaway on Mulgrave Road	×	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	-
Group8_026	Sutton Junction	Source Control, Attenuation and SuDS	Length of connecting swale along the edge of Overton Grange School playing fields	✓	Swales	16	m^2 of swale area	m2		450	1	450		<£25k	£501k - 1m
		Flood Storage / Permeability	Storage Area at Overton Grange School playing fields	✓	Detention Basins	33	m3 of detention volume	m3				28000		£501k - 1m	
		Other - Improvement to Drainage Infrastructure	New section of pipe along Cedar Road	✓	Increasing Capacity in Drainage Systems	118 1710	m of pipe dia.900mm per manhole	m per manhole	240 -				- 5	£26k - 50k	
Group8_027	Carshalton Beeches	Source Control, Attenuation and SuDS	Soakaway at Barrow Hedges Way	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	£51k - 100k
		Source Control, Attenuation and SuDS	Soakaway at Banstead Road	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	
		Other - Improvement to Drainage Infrastructure	Additional gullies at 4 locations on Barrow Hedges Way and Banstead Road	✓	Increase the number or size of gullies to collect runoff and discharge to sewer	215	per gully	per gully					4	<£25k	
		Source Control, Attenuation and SuDS	Swale around the edge of Barrow Hedges School	✓	Swales	16	m^2 of swale area	m2		480	1	480		<£25k	
		Other - Improvement to Drainage Infrastructure	New section of pipe along Woodmansterne Road adjacent to Wellfield Gardens	✓	Increasing Capacity in Drainage Systems	118 1710	m of pipe dia.900mm per manhole	m per manhole	200 -				- 5	£26k - 50k	
Group8_028	Carshalton Centre	Source Control, Attenuation and SuDS	Swale connecting to a storage area in the playing fields adjacent to The Grove Recreation Ground	✓	Swales	16	m^2 of swale area	m2		300	1	300		<£25k	£251k - 500k
		Flood Storage / Permeability	Storage Area in playing fields adjacent to The Grove Recreation Ground	✓	Detention Basins	33	m^3 of detention volume	m3				10000		£251k - 500k	
Group8_029	Beddington Gardens	Source Control, Attenuation and SuDS	Soakaway on Park Hill Road	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	<£25k
		Source Control, Attenuation and SuDS	Soakaway on Beddington Gardens	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	
Group8_030	Wallington Rail Bridge	Schemes already implemented	None	N/A		N/A	N/A	N/A						N/A	-
Group8_031	South Beddington	Source Control, Attenuation and SuDS	Soakaway on Lavender Vale	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	<£25k
		Source Control, Attenuation and SuDS	Soakaway on Demesne Road	✓	Soakaways	219	m^3 of stored volume	m3		7	6	42		<£25k	
Group8_032	Beddington Park	Other - Improvement to Drainage Infrastructure	New section of pipe along Wandle Road to provide additional storage	×	Increasing Capacity in Drainage Systems	118 1710	m of pipe dia.900mm per manhole	m per manhole	250 -				- 5	£26k - 50k	-
Group8_033	Hackbridge	De-culvert / Increase Conveyance	None	N/A	Feasibility study	N/A	N/A	-	-	-	-	-	-	<£25K	£26K-50K
		Other - Improvement to Drainage Infrastructure	Drainage Capacity Investigation	✓	Drainage capacity study	N/A	N/A	-	-	-	-	-	-	<£25K	

Note: This table has been produced to assist with the preliminary cost estimates as part of the SWMP for London Borough of Sutton dimensions and costs are indicative and should only be used for preliminary estimates due to the generalised nature of the information used to compile it. An estimated cost for the preferred flood mitigation option for each identified CDA has been calculated based on standard unit costs provided as part of Tier 1 of the Drain London Project. No monetised damages have been calculated, and flood mitigation costs have been determined using engineering judgement, but have not undergone detailed analysis. The following standard assumptions have been applied, as determined in the Drain London Prioritisation Matrix Guidance:

- The costs are the capital costs for implementation of the scheme only.
- Costs do not include provisions for consultancy, design, supervision, planning process, permits, environmental assessment or optimum bias.
- No provision is made for weather (e.g. winter working).
- No provision is made for access constraints
- Where required, it will be stated if costs include approximate land acquisition components.
- No operational or maintenance costs are included.
- No provision is made for disposal of materials (e.g. for flood storage or soakaway clearance).

As a result, costs have been provided as cost bands, reflecting the strategic nature of the SWMP study and options identification.

4.6 Option Prioritisation

4.6.1 The Prioritisation Matrix was developed out of the need for a robust, simple and transparent methodology to prioritise the allocation of funding for surface water management schemes across the 33 London Boroughs by the Drain London Programme Board. As such, the prioritisation should be understood in the high-level decision-making context it was designed for. It is not intended to constitute a detailed cost-benefit analysis of individual surface water flood alleviation schemes.

4.6.2 The information within Table 4-7 will used by the Drain London Programme Board to populate the Drain London Prioritisation Matrix and identify schemes to be taken forward under the Tier 3 package of works.

Table 4-7 Phase 3 Summary of Preferred Options – *For input into Drain London Prioritisation Matrix*

CDA ID	Scheme Location	Scheme Category *	Infrastructure						Households				Commercial / Industrial		Capital Cost Band
			Essential		Highly Vulnerable		More Vulnerable		Non-Deprived (All)		Deprived (All)		All		
			Eliminated (%)	Mitigated (%)	Eliminated (%)	Mitigated (%)	Eliminated (%)	Mitigated (%)	Eliminated (%)	Mitigated (%)	Eliminated (%)	Mitigated (%)	Eliminated (%)	Mitigated (%)	
Group8_022	Worcester Park/Green Lane	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Group8_023	Trafalgar Avenue	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Group8_024	Sandy Lane	1	N/A	N/A	N/A	N/A	N/A	N/A	0	15%	N/A	N/A	0	100%	<£25K
Group8_025	York Rd/Mulgrave Rd	1	N/A	N/A	N/A	N/A	0	0	0	10%	N/A	N/A	0	0	<£25K
Group8_026	Sutton Junction	1,2,3	0	70%	N/A	N/A	N/A	N/A	0	10%	N/A	N/A	0	30%	£501K-1M
Group8_027	Carshalton Beeches	1,3	N/A	N/A	N/A	N/A	0	65%	0	15%	N/A	N/A	0	90%	£51K-100K
Group8_028	Carshalton Centre	1,2	N/A	N/A	N/A	N/A	0	0	0	10%	N/A	N/A	0	0	£251K-500K
Group8_029	Beddington Gardens	1	N/A	N/A	N/A	N/A	0	0	0	10%	N/A	N/A	0	0	<£25K
Group8_030	Wallington Rail Bridge	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Group8_031	South Beddington	1	N/A	N/A	0	0	0	0	0	10%	N/A	N/A	0	15%	<£25K
Group8_032	Beddington Park	3	N/A	N/A	N/A	N/A	0	0	0	30%	N/A	N/A	0	10%	£26K-50K
Group8_033	Hackbridge	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

***Scheme Categories** 1 - Source Control, Attenuation & SuDS; 2 - Flood Storage / Permeability; 3 - Improvements to Drainage Infrastructure

Note: The Drain London Prioritisation Matrix requires an estimation of the percentage of total number of units that have the potential to benefit from the proposed scheme. This has been determined by calculating the number of units within the Local Flood Risk Zone that the scheme has been designed to mitigate, as a percentage of the number of units within the CDA as a whole. The input is restricted to multiples of five percent. It should be noted that the information within this table is purely for input into the Drain London Prioritisation Matrix and should be treated as such.

5. Phase 4: Implementation and Review

5.1 ACTION PLAN

5.1.1 The purpose of Phase 4 of the SWMP is to clearly identify actions and responsibilities for the ongoing management of surface water flood risk within the London Borough of Sutton that have been identified throughout the work undertaken in Phases 1 to 3.

5.1.2 A draft Action Plan has been prepared for London Borough of Sutton and is included within Appendix I. The purpose of the Action Plan is to:

- Outline the actions required to implement the preferred options identified in Phase 3;
- Identify the partners or stakeholders responsible for implementing the action;
- Provide an indication of the priority of the actions and a timescale for delivery;
- Outline actions required to meet the requirements for London Borough of Sutton as LLFA under the FWMA 2010.

5.1.3 Actions within the draft Action Plan (Appendix I) have been categorised as summarised in Table 5-1 and a summary of the key actions falling within each category if provided within the following sections.

Table 5-1 Types of Action within the London Borough of Sutton Action Plan

Definition	Action Type Abbreviation	Description
Flood and Water Management Act / Flood Risk Regulations	FWMA / FRR2009	Duties and actions as required under the FRR2009 and FWMA - Refer to Appendix A of the LGG 'Preliminary Framework to assist the development of the Local Strategy for Flood Risk Management' (February 2011) for minimum requirements.
Policy Action	Policy	Spatial planning or development control actions.
Communication / Partnerships	C+M	Actions to communicate risk internally or externally to LLFA or create / improve flood risk related partnerships.
Financial / Resourcing	F+R	Actions to secure funding internally / externally to support works or additional resources to deliver actions.
Investigation / Feasibility / Design	I/F/D	Further investigation / feasibility study / Design of mitigation.
Flooding Mitigation Action	FMA	Maintenance or capital works undertaken to mitigate flood risk.

5.1.4 As part of the preparation of the draft Action Plan and the SWMP, the requirement for a Strategic Environmental Assessment (SEA), an Appropriate Assessment (required by the Habitats Directive) or an Article 4.7 assessment (under the Water Framework Directive) was considered. A 'screening decision' was made which suggested that the SWMP alone does not require any of the environmental assessments described above. However, it is possible that any actions which are taken forward will require such assessments and it is envisaged that the requirement for this will form part of feasibility studies for individual schemes.

Key Actions – FWMA 2010 / FRR 2009

5.1.5 As identified in Table 5-1, a number of the key actions for London Borough of Sutton relate to duties and responsibilities under the FWMA and the FRR2009 outlined in Section 1.7.

5.1.6 The actions required are contained in the draft Action Plan, however of chief importance and immediacy for London Borough of Sutton are:

- Implement a standardised Flood Incident Log and investigate flooding incidents.
- Implement and populate a standardised Asset Register.
- Establish a Flood Risk Management Group for London Borough of Sutton.
- Formalise Terms of Reference for the South West London Strategic Flood Group.

5.1.7 It is likely that these actions may require consideration of internal Borough functions, roles of specific personnel, and adopting new systems of data collection and asset management.

Key Actions – Policy

5.1.8 Actions that will need to be delivered through policy include policies or strategies for influencing the use of rainwater harvesting techniques, managing driveway resurfacing and associated drainage, and the use of SuDS. These may be delivered across the Borough or for specific Policy Areas within the Borough.

- Ensure Development Control policies incorporate consideration of surface water flood risk.
- Establish Development Control policy on Driveway and Garden repaving.

Key Actions – Communications / Partnerships

5.1.9 As our understanding about surface water flood risk improves and more information is made available, it becomes increasingly important to be able to communicate the risk effectively both within the London Borough of Sutton and to other stakeholders and members of the public. To this end a number of actions relate to the future communication of flood risk and the London Borough of Sutton have begun to consider the implementation of a Communication Plan to deliver this action.

5.1.10 Building on the success of the Sutton Flood Group and continuing to forge partnerships with neighbouring London Boroughs through the establishment of the South West London Flood Group will be essential to the continued management of surface water across this area in a joined-up manner. Collaboration with neighbouring London Boroughs is also likely to aid each local authority in meeting the requirements of the FRR2009 and taking on new roles and responsibilities under the FWMA.

5.1.11 Key actions from the draft Action Plan under this category include:

- Establish a Communication and Engagement Plan.
- Increase community awareness of local flood risk through letter drops and Community Flood Plans.
- Actively engage political stakeholders in local flood risk management.
- Establish a Flood Risk Management Group for London Borough of Sutton.
- Formalise Terms of Reference for the South West London Strategic Flood Group.

Key Actions – Financial / Resourcing

5.1.12 In order to deliver the requirements of the FWMA 2010 and, to a lesser extent, the FRR 2009, alongside the local flood risk management actions identified in this SWMP, London Borough of Sutton is likely to require additional resources and funding over the long-term. Key actions from the draft Action Plan under this category include:

- Ensure required skills and technical capability is in place to deliver FWMA 2010 / FRR 2009 requirements.
- Identify local flood risk management funding opportunities through internal and external, existing and future, funding initiatives and mechanisms.

Key Actions – Investigation / Feasibility / Design

5.1.13 As well as these Borough-wide actions, a number of actions have been identified for specific CDAs based upon the preferred options identified for each CDA. Within London Borough of Sutton, these are predominantly either capital works in the form of SuDS and creation of flood storage areas, or further investigation through more detailed modelling and initial surveys, or where appropriate feasibility studies.

5.1.14 Key actions from the draft Action Plan under this category include:

- Undertake a Drainage Capacity Study for Hackbridge and South Beddington (CDA 033, CDA 032) to determine the drainage capacity and upgrade requirements.
- In conjunction with Thames Water, determine the capacity of the existing sewer network along Cedar Road (CDA_026 Sutton Junction) and continue to discuss options for increasing the surface water sewer capacity at this location.
- Consider undertaking a feasibility study to assess the potential for flood storage in Overton Grange School Playing Fields (CDA_026 Sutton Junction).
- Consider undertaking a feasibility study to assess the potential for flood storage in The Grove Recreation Ground (CDA_028 Carshalton Centre).
- Consider undertaking a feasibility study to assess the potential benefits of de-culverting the watercourse in Mill Green (CDA_033 Hackbridge), as identified in the Draft Hackbridge Climate Change Adaptation Plan.

Key Actions – Flooding Mitigation Action

5.1.15 Flooding mitigation actions include maintenance or capital works which can be can be progressed without any further investigation to mitigate flood risk. The following actions have been extracted from the draft Action Plan as examples of key actions for consideration under this category:

- Continue to undertake drainage maintenance that prioritises LFRZs.
- Encourage gully cleansing contractors to use powers to enforce movements of parked cars to ensure all gullies are regularly maintained.
- Consider the installation of soakaways and other preferred capital schemes identified in Chapter 4.

5.2 Ongoing Monitoring

5.2.1 The partnership arrangements established as part of the SWMP process (e.g., London Borough of Sutton, Environment Agency, TfL and TWUL working in collaboration) should continue beyond the completion of the SWMP in order to discuss the implementation of the proposed actions, review opportunities for operational efficiency and to review any legislative changes.

5.2.2 The SWMP Action Plan should be reviewed and updated once every six years as a minimum, but there may be circumstances which might trigger a review and/or an update of the Action Plan in the interim, for example:

- Occurrence of a surface water flood event;
- Additional data or modelling becoming available, **which may alter the understanding of risk within the study area;**
- If the outcome of an investment decision by partners is different to the preferred option, which may require a revision to the Action Plan, and;
- Additional (**major**) development or other changes in the catchment which may affect the surface water flood risk.

Recommendation 28: Develop, maintain and update the draft Action Plan to meet London Borough of Sutton's local flood risk management priorities.

5.3 Updating SWMP Reports and Figures

5.3.1 In recognition that the SWMP will be updated in the future, the report has been structured in chapters according to the SWMP guidance provided by Defra. By structuring the report in this way, it is possible to undertake further analyses on a particular source of flooding and only have to supersede the relevant chapter, whilst keeping the remaining chapters unaffected.

5.3.2 In keeping with this principle, the following tasks should be undertaken when updating SWMP reports and figures:

- Undertake further analyses as required after SWMP review;
- Document all new technical analyses by rewriting and replacing relevant chapter(s) and appendices;
- Amend and replace relevant SWMP Maps; and,
- Reissue to departments within the London Borough of Croydon and other stakeholders.

6. References

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DCLG (Revised 2010) Planning Policy Statement 25: Development & Flood Risk

Defra (March 2010) Surface Water Management Plan Technical Guidance.

Defra (2009) National Rank Order of Settlements Susceptible to Surface Water Flooding.

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Scott Wilson (December 2008) Level One Strategic Flood Risk Assessment for London Boroughs of Wandsworth, Merton, Sutton and Croydon.

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Water Research Centre (WRC), 2006, Sewers for Adoption (6th Edition)

Limitations

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The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by URS Scott Wilson has not been independently verified by URS Scott Wilson, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by URS Scott Wilson in providing its services are outlined in this Report. The work described in this Report was undertaken between September 2010 and June 2011 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

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Where field investigations are carried out, these have been restricted to a level of detail required to meet the stated objectives of the services.

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No allowance has been made for changes in prices or exchange rates or changes in any other conditions which may result in price fluctuations in the future. Where assessments of works or costs necessary to achieve compliance have been made, these are based upon measures which, in URS Scott Wilson's experience, could normally be negotiated with the relevant authorities under present legislation and enforcement practice, assuming a pro-active and reasonable approach by site management.

Forecast cost estimates do not include such costs associated with any negotiations, appeals or other non-technical actions associated with the agreement on measures to meet the requirements of the authorities, nor are potential business loss and interruption costs considered that may be incurred as part of any technical measures.

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Appendix A - Data Review

A review of the data provided as part of Drain London Tier 1 package of works and that used within this SWMP has been undertaken. An assessment of the quality of the data has been completed, using the criteria set out in the Defra SWMP Guidance, which is summarised in Table A-1 of Appendix A.

DLT2-GP8-SWMP-Sutton-AppendixA-DataReview_v1pt0.xls

Appendix B - Asset Register Recommendation

A review of the data provided as part of Drain London Tier 1 package of works and that used within this SWMP has been undertaken and is provided electronically alongside this report.

DLT2-GP8-SWMP-Sutton-AppendixA-DataReview_v1pt0.xls

Appendix C - Risk Assessment: Technical Details

Appendix C1 – Pluvial Modelling Methodology

DLT2-GP8-SWMP-Sutton-AppendixB-AssetRegister_V0pt3.pdf

Appendix C2 – Intermediate Assessment of Groundwater Flooding Susceptibility

DLT2-GP8-SWMP-Sutton-AppendixC2-GroundwaterAssessment.pdf

Appendix D - Maps

The following supporting figures have been supplied electronically alongside this report.

D1	Environment Agency Flood Map for Surface Water
D2	1% AEP Maximum Flood Depth & Recorded Surface Water Flooding Incidents
D3	Environment Agency Flood Map and Fluvial Flooding Incidents
D4	Thames Water Sewer Network
D5	Recorded Incidents of Sewer Flooding
D6	3.3% AEP Rainfall Event: Maximum Flood Depth + CDA
D7	3.3% AEP Rainfall Event: Hazard Rating + CDA
D8	1.3% AEP Rainfall Event: Maximum Flood Depth + CDA
D9	1.3% AEP Rainfall Event: Hazard Rating + CDA
D10	1% AEP Rainfall Event plus Climate Change: Maximum Flood Depth + CDA
D11	1% AEP Rainfall Event plus Climate Change: Hazard Rating + CDA
D12	0.5% AEP Rainfall Event: Maximum Flood Depth + CDA
D13	0.5% AEP Rainfall Event: Hazard Rating + CDA

Appendix E - Options Assessment Details

The **draft** Options Assessments for each CDA have been undertaken in Excel Worksheets. These are provided electronically as part of this report alongside the Drain London Unit Costing Spreadsheet.

DLT2-GP8-SWMP-Sutton-AppendixE-Options_V0pt2.pdf

Appendix F - Peer Review

The Peer Review undertaken as part of this SWMP is provided electronically alongside this report.

DLT2-GP8-SWMP-Sutton-AppendixF-PeerReview_V0pt1.pdf

Appendix G - Spatial Planner Information Pack

A Spatial Planning Information Pack has been produced as part of the SWMP and is provided electronically alongside this report.

DLT2-GP8-SWMP-Sutton-AppendixG-SpatialPlanning_V0pt2.pdf

Appendix H - Resilience Forum and Emergency Planner Information Pack

A Resilience Forum and Emergency Planner Information Pack has been produced as part of the SWMP and is provided electronically alongside this report.

DLT2-GP8-SWMP-Sutton-AppendixG-EmergencyPlanning_V0pt2.pdf

Appendix I - Action Plan

The **draft** Action Plan for the London Borough of Sutton has been provided as an Excel Worksheet alongside this report.

DLT2-GP8-SWMP-Sutton-AppendixI-ActionPlan-V0pt2_DRAFT.xls