FOR ISSUE

AECOM Imagine it. Delivered.

Surface Water Management Plan

London Borough of Lambeth

Project reference: LoHAC Central Borough 1
Project number: 60581765

14th May 2021

Quality information

Prepared by	Checked by	Verified by	Approved by
Sarah Betts Water Consultant Alice Pistolesi Senior Engineer	Alice Pistolesi Senior Engineer Matthew Ince Regional Director	Matthew Ince Regional Director	Dan Glasson Associate Director

Revision History

Revision	Revision date	Details	Authorised	Name	Position
01	8th March 2021	For Comment issued in Word format	DG	Dan Glasson	Associate Director
02	21st April 2021	Final for Issue	DG	Dan Glasson	Associate Director
03	14th May 2021	Updated with minor comments from the Client	DG	Dan Glasson	Associate Director

Distribution List

# Hard Copies	PDF Required	Association / Company Name
N/A	Yes	London Borough of Lambeth

Prepared for:

London Borough of Lambeth

Prepared by:

Sarah Betts
Water Consultant

Alice Pistolesi
Senior Engineer

AECOM Infrastructure & Environment UK Limited
Sunley House
4 Bedford Park, Surrey
Croydon CRO 2AP
United Kingdom

T: +44 20 8639 3500
aecom.com

Table of Contents

1. Introduction 12
1.1 What is a Surface Water Management Plan? 12
1.2 SWMPs in Context 12
1.3 Scope of the SWMP Study Update 13
1.3.1 SWMP Phases 13
1.3.2 Aims and Objectives 14
1.3.3 Relationship to Other Plans 15
1.4 Study Area 17
1.4.1 Topography and Land Use 17
1.4.2 Flood Risk Overview 18
2. Phase 1: Preparation 19
2.1 Lambeth SWMP (2011) 19
2.2 Requirement for an SWMP Update 19
2.3 Previous Modelling Studies 20
2.3.1 Background 20
2.3.2 Thames Water Crossness Strategic & Detailed Modelling 20
2.3.3 Detailed Modelling Studies 20
2.4 Partnerships 20
2.4.1 Who should be involved 20
2.4.2 Roles & Responsibilities 21
2.5 Scope of the SWMP 21
2.5.1 Set Objectives 21
2.5.2 Engagement Plan 22
2.5.3 Available Information 22
2.5.4 Data Limitations 23
2.5.5 High Level Assessment 23
3. Phase 2: Risk Assessment 24
3.1 Borough-Level Current and Future Flood Risk 24
3.1.1 Present Day Flood Risk 24
3.1.2 Future Flood Risk 31
3.2 CDAs 33
3.2.1 Methodology 33
3.2.2 Damage Assessment 35
3.2.3 Flooding Mechanisms at CDA Level 38
4. Phase 3: Options 50
4.1 Objectives 50
4.2 Measure Identification 50
4.3 Options Assessment 53
4.3.1 Long List of Potential Options 53
4.3.2 Short List of Potential Options 64
5. Phase 4: Implementation & Review 101
5.1 Action Plan 101
5.2 Implement and Review Action Plan 106
5.2.1 Review Timeframe and Responsibilities 106
5.2.2 Ongoing Monitoring 106
5.2.3 Updating SWMP Reports and Figures 106

6. References 107

Appendices

Appendix A CDA Delineation Methodology
Appendix B Lambeth Hydraulic Modelling Model Build Report
Appendix C Maps
Appendix D Damage Assessment Details
D.1 Methodology
D.2 Damage Assessment for each CDA
D.3 Damage Assessment for each LBL ward
Appendix E Options Assessment Details
E.1 Long List of Options
E.2 Highways Green Infrastructure Potential Map

Figures

Figure 1 Wheel diagram illustrating the SWMP framework (Source: Surface Water Management Plan Technical Guidance, March 2010, DEFRA) 13
Figure 2 Topography across the London Borough of Lambeth (0.5m DTM LiDAR) 17
Figure 3 Residential properties at risk of flooding for the 1% AEP within the London Borough of Lambeth by ward 26
Figure 4 Flood depths for 1% AEP storm event across the London Borough of Lambeth 27
Figure 5 Flow velocities for the 1% AEP storm event for the London Borough of Lambeth .. 28
Figure 6 Hazard ratings for the 1% AEP storm event for the London Borough of Lambeth .. 29
Figure 7 Comparison of areas at high (3.3% AEP), medium (1% AEP) and low (0.1% AEP) risk of flooding from surface water across the London Borough of Lambeth 30
Figure 8 Comparison of areas at risk of flooding between the 1% AEP and the 1% AEP + 40% CC storm events across the London Borough of Lambeth 32
Figure 9 Critical Drainage Areas for the London Borough of Lambeth 34
Figure 10 Residential Properties at Risk of Flooding within the London Borough of Lambeth by CDA, for the 1% AEP 36
Figure 11 Distribution of Damages within the London Borough of Lambeth for the 1% AEP storm event 37
Figure 12 Clapham CDA Flood Depths for the 1% AEP 39
Figure 13 Oval CDA Flood Depths for the 1% AEP 40
Figure 14 Railton Road CDA Flood Depths for the 1% AEP 41
Figure 15 South Lambeth CDA Flood Depths for the 1% AEP 42
Figure 16 Streatham CDA Flood Depths for the 1% AEP 43
Figure 17 Streatham Hills CDA Flood Depths for the 1% AEP 44
Figure 18 Streatham Vale CDA Flood Depths for the 1% AEP 45
Figure 19 Tulse Hill CDA Flood Depths for the 1% AEP 46
Figure 20 Wandsworth Road CDA Flood Depths for the 1% AEP 47
Figure 21 West Dulwich CDA Flood Depths for the 1% AEP 48
Figure 22 West Norwood CDA Flood Depths for the 1% AEP 49
Figure 23 Source-Pathway-Receptor Model (Source: SWMP Technical Guidance, 2010) ... 51
Figure 24 Parks located within the London Borough of Lambeth 55
Figure 25 Estates managed by the London Borough of Lambeth 57
Figure 26 SuDS Management Train (Source: SusDrain) 59
Figure 27 Example of the Highways Green Infrastructure Potential Map for the West Norwood area 60
Figure 28 Highways Green Infrastructure Potential Map for the London Borough of Lambeth 61
Figure 29 Key highways affected by flood risk within the London Borough of Lambeth for the 1% AEP storm event 63
Figure 30 Scoring System established to compare the updated SWMP Long List of Options 65
Figure 31 Examples of Permeable Front Gardens Allowing for Parking (Source: CLG/EA Guidance on the permeable surfacing of front gardens 2008; Richmond Scrutiny Report 2008) 66
Figure 32 Example Rainwater Harvesting System in a Commercial Property (Source: Rainwater harvesting systems UK) 69
Figure 33 Example of a 100L water butt retrofitted to existing development 70
Figure 34 Example of raised property threshold (gate threshold on Dulwich Road and property threshold on Robson Road, LBL) 71
Figure 35 Bowland Road Estate (view from Bowland Road) and Clapham Crescent 76
Figure 36 Indicative flood storage areas around the Bowland Road Estate 76
Figure 37 Kendoa Road and Cato Road pedestrianised area 78
Figure 38 Proposed raised pavement and flood storage area by Cato Road 78
Figure 39 Example of green infrastructure providing flood storage in a pedestrian environment (Source: SusDrain) 78

Figure 40 Railton Road Traffic Reduction Scheme 80
Figure 41 Proposed segment of Railton Road for incorporation of SuDS 80
Figure 42 Example of SuDS incorporated in traffic calming measures and extended pavements (Source: SusDrain[30]) 80
Figure 43 Green areas around the Solon Road Estate 82
Figure 44 Indicative areas for flood storage and roof disconnections around the Solon Estate 82
Figure 45 Example of roof disconnections draining into raingardens (Source: SusDrain[30]) . 82
Figure 46 Larkhall Park on Courland Grove side and by the playground (opportunities to incorporate respectively swales and natural attenuation) 84
Figure 47 Indicative area for flood storage and swales within Larkhall Park 84
Figure 48 Example of shallow swales in parks (Source: SusDrain[30]) 84
Figure 49 Paved areas in Blore Close and by Bilton House to be replaced with raingardens and permeable paving 86
Figure 50 Indicative areas of permeable pavement and flood storage around Blore Close and by Bilton House 86
Figure 51 Thessaly Road open space 88
Figure 52 Thessaly Road open space and indicative flood storage extent 88
Figure 53 Example of detention basin within small green open space (Source: SusDrain[30]) 88
Figure 54 Stanthorpe Close Estate (opportunity for raingardens and tree pits) 90
Figure 55 Proposed flood storage area and raingarden conversion within the Stanthorpe Close Estate 90
Figure 56 Example sunken raingardens providing flood storage in urban environments (Source: SusDrain[30]) 90
Figure 57 St Anselms Court Estate (opportunity for raingardens and tree pits) 92
Figure 58 Proposed area to route and store water from Oakdale Road in the St Anselms Court Estate 92
Figure 59 The Rookery, Gardens 94
Figure 60 Areas available for routing and storage of surface water around the Rookery 94
Figure 61 Example of terraced flood storage area (Source: SusDrain[30]) 94
Figure 62 Meadow Park, London Borough of Southwark 96
Figure 63 Area available for flood storage within Meadow Park 96
Figure 64 Norwood Park 98
Figure 64 Indicative flood storage areas within Norwood Park 98
Figure 65 Example of shallow detention basin providing flood storage (Source: SusDrain[30]) 98
Figure 67 Astley House aerial view (opportunity for a detention basin) and from Gipsy Hill (opportunity for raingardens) 100
Figure 68 Indicative flood storage and roof disconnection areas around Astley House 100
Figure 69 Example roof disconnections draining into raingardens at the foot of the estate (Source: SusDrain[30]) 100

Tables

Table 1 Key Terminology and Acronyms 9
Table 2 History of Detailed Surface Water Modelling within the London Borough of Lambeth 20
Table 3 Data Sources 23
Table 4 Comparison of maximum flood depth and total areas at risk of flooding 24
Table 6 Critical Drainage Areas for the London Borough of Lambeth 33
Table 7 Residential Properties at Risk of Flooding in the London Borough of Lambeth, by CDA 35
Table 8 Structural and Non-Structural Measures for Consideration 51
Table 9 Measures Opportunity Assessment 52
Table 10 London Borough of Lambeth Highways Classification Methodology 58
Table 11 Key highways affected by flood risk within LBL 62
Table 12 Types of Actions with the LBL Action Plan 101
Table 13 Actions from the London Borough of Lambeth SWMP 102

Key Terminology and Acronyms

The key terms referenced throughout this document are presented in Table 1 below:

Table 1 Key Terminology and Acronyms

Term	Definition
AEP	Annual Exceedance Probability - Chance or probability of a natural hazard event occurring annually, expressed as a percentage.
CFMP	Catchment Flood Management Plan - High-level planning strategy through which the Environment Agency works with 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 - 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.
CIRIA	Construction Industry Research and Information Association
CC	Climate Change – Long-term variations in global temperature and weather patterns caused by natural and human actions.
DEFRA	Department for Environment, Food and Rural Affairs
DEM	Digital Elevation Model
DTM	Digital Terrain Model
EA	Environment Agency – Public body responsible for managing flood risk from rivers and coastal sources and for working with local authorities to provide guidance on understanding, managing and mitigating flood risk from rivers, the sea, surface water, groundwater and reservoirs.
Flood Defence	Infrastructure used to protect an area against floods such as flood walls and embankments; they are designed to a specific standard of protection (design standard).
Fluvial Flooding	Flooding from a watercourse.
GLA	Greater London Authority – Regional planning authority for the Greater London area.
Groundwater Flooding	Overland flows resulting from groundwater sources where groundwater is defined as all water which is below the surface of the ground and in direct contact with the ground or subsoil.
IDB	Internal Drainage Board – Public body responsible for managing water levels in areas of the country with special drainage needs.
LBC	London Borough of Croydon

LBL	London Borough of Lambeth (also referred to as “the Borough”)
LBM	London Borough of Merton
LBS	London Borough of Southwark
LBW	London Borough of Wandsworth
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management in a certain area.
LPA	Local Planning Authority - Local Authority responsible for taking the lead on urban planning functions in a certain area.
Main River	A watercourse for which the Environment Agency has responsibilities and powers.
NFM	Natural Flood Risk Management
NRD	National Receptor Dataset - 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.
PFRA	Preliminary Flood Risk Assessment. A PFRA provides a high-level summary of significant flood risk from all sources based on available information on both past and future flooding.
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 resulting from high intensity rainfall when water ponds or flows over the ground surface before it enters the below-ground drainage network or watercourse or cannot enter it because the network is at capacity.
RMA	Risk Management Authority – The Environment Agency, Lead Local Flood Authorities, water companies and highway authorities.
RFRA	Regional Flood Risk Assessment
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.
Sewer Flooding	Flooding which occurs when the capacity of the underground system is exceeded due to heavy rainfall, resulting in flooding inside and outside of buildings. Sewer flooding as a result of blockage or failure is excluded from the SWMP as this is the responsibility of the utility provider.
SFRA	Strategic Flood Risk Assessment

Stakeholder	A person or organisation affected by a problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and structures that are designed to drain surface water more controlled manner than some conventional techniques.
Surface Water	Rainwater which is on the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
SWMP	Surface Water Management Plan
SWHZs	Surface Water Hazard Zones – Areas where flood risk has been identified as posing a “Danger for Some” based on depth of flooding and velocity of floodwaters, as defined by DEFRA. SWHZs were used to define the CDAs.
TfL	Transport for London
TW	Thames Water Utilities Ltd

1. Introduction

1.1 What is a Surface Water Management Plan?

A Surface Water Management Plan (SWMP) outlines the preferred surface water management strategy for a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater, runoff from land and small watercourses and ditches that occurs as a result of heavy rainfall.

The Department for Environment, Food and Rural Affairs (DEFRA) published guidance on SWMPs in 2010[1] and provided the following description:

“A SWMP study is undertaken in consultation with key local partners who are responsible for surface water management and drainage in their area. Partners work together to understand the causes and effects of surface water flooding and agree the most cost-effective way of managing surface water flood risk for the long-term. The process of working together as a partnership is designed to encourage the development of innovative solutions and practices.

A SWMP should establish a long-term action plan to manage surface water in an area and should influence capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.”

1.2 SWMPs in Context

Over the past decade, the increasing threat of climate change in line with the growing demand on London’s drainage infrastructure has led to the introduction of more robust policies at a regional scale to which development planning is required to adhere to. The need to better understand flood risk in order to inform sustainable development of central London has led to improvements in technology in both the way flood risk is modelled and our approach to flood risk management, with a shift towards catchment-based approaches.

These involve reducing the amount and rate of runoff in the upper part of catchments of at-risk locations, primarily using Sustainable Drainage Systems (SuDS) and “natural flood risk management” (NFM) methods. Mitigation measures are broken down into “source”-“pathway”-“receptor” segments and are implemented through planning policies or as part of council schemes. These methods also provide water quality, biodiversity and amenity benefits.

Furthermore, the summer flood events of 2007 prompted the Pitt Review[2] which recommended that SWMPs are adopted, particularly in areas with high surface water flood risk.

The Government response to the Pitt Review[3] led to the passing of the Flood and Water Management Act (2010)[4] which devolves local flood risk management to Lead Local Flood Authorities (LLFAs), in partnership with other stakeholders such as water companies.

In addition, in July 2018 the UK Government published a surface water management action plan[5] which clarified the surface water responsibilities set out in the Flood and Water Management Act. The Action Plan was published to address the increase in surface water flood risk to millions of properties in the UK due to climate change causing more frequent and

[1] Department for Environment, Food and Rural Affairs (DEFRA), Surface Water Management Plan Technical Guidance, March 2010.
[2] Sir Michael Pitt, Learning Lessons from the 2007 floods, June 2008.
[3] DEFRA, The Government’s Response to Sir Michael Pitt’s Review of the summer 2007 Floods Progress Report, December 2009.
[4] UK Government, Flood and Water Management Act, 2010. Available from : https://www.legislation.gov.uk/ukpga/2010/29/contents . Accessed January 2021.
[5] DEFRA, Surface Water Management – An Action Plan, July 2018.

intense storms, ageing sewerage infrastructure and increase in development drainage requirements. The plan's key actions focused on the development and empowerment of LLFAs to improve the incorporation of surface water management within the planning process and improve understanding and assessment of surface water flood risk.

Recent flood events in 2007, 2014 and during the winter of 2020 affected areas across the UK, including the London Borough of Lambeth (LBL). Large urban areas such as London have a higher risk of surface water flooding during those events due to the extent of impermeable surface and limited capacity of the sewer network. To mitigate the increasing risk of surface water flooding in the future it is paramount that, in line with the policies and guidance set out above, all stakeholders collaborate to improve understanding and management of surface water.

1.3 Scope of the SWMP Study Update

1.3.1 SWMP Phases

The DEFRA 2010 SWMP Guidance[1] suggests the SWMP follows a four-part structure. Figure 1 identifies the four principal phases: Preparation; Risk Assessment; Options; and Implementation and Review.

Figure 1 Wheel diagram illustrating the SWMP framework (Source: Surface Water Management Plan Technical Guidance, March 2010, DEFRA)

The first three phases involve undertaking the SWMP study, whilst the fourth phase involves producing and implementing the action plan based on the evidence gained from the preceding three phases. Further detail on each phase is given below.

1. Preparation

The first phase of a SWMP study is the preparation and scoping of the requirements of the study. One of the key components of the SWMP is establishing the partnership between the relevant stakeholders, mainly: LBL, TW and the EA. Active engagement throughout the

process is essential due to the different responsibilities and competing interests held by each stakeholder.

2. Risk Assessment

The risk assessment phase of the SWMP initially looks at the LBL as a whole and identifies areas that are more vulnerable to surface water flood risk (Surface Water Hazard Zones (SWHZs) using hydraulic modelling outputs. This section of the SWMP explains the flood mechanisms for each of these vulnerable areas through a catchment-based approach by defining Critical Drainage Areas (CDAs) based on topography, surface water flow paths and below-ground sewerage infrastructure.

3. Options

Several options are identified for each CDA, guided by stakeholder engagement, to mitigate the risk of surface water flooding within CDAs. A long list of options is first prepared and scrutinised to eliminate those that are unfeasible. Those remaining should be developed and examined for their relative cost-benefit effectiveness as part of a future study before been taken forward.

4. Implementation and Review

The final phase of the SWMP is about implementing an action plan for delivering the agreed actions and monitoring the implementation of these actions. All options implemented in the future should be monitored to assess their outcomes and benefits and the SWMP periodically reviewed and updated.

1.3.2 Aims and Objectives

The objectives of the SWMP are to:

- Develop a robust understanding of surface water flood risk in and around the study area, considering the challenges of climate change, population and demographic change and increasing urbanisation in London;
- Create a detailed 1D-2D integrated surface water model of the LBL using the latest data and up-to-date software. This will be verified against TW assets and data records;
- Redefine the CDAs based on the updated modelling. New designations will be based on a combination of surface water flow paths and areas of significant surface water ponding;
- Using the CDAs, the SWMP will formulate a succinct action plan detailing the recommendations for managing surface water across the Borough which will improve emergency and land-use planning and enable better flood risk and drainage infrastructure investments;
- Establishment and consolidation of partnerships between the key drainage stakeholders to facilitate collaborative working practices and identification of cross-boundary working opportunities;
- Engagement with stakeholders to raise awareness of surface water flooding, identify flood risks, flood assets and to agree on the mitigation measures and actions moving forward;
- The outputs of the study will focus on creating tangible outcomes that provide betterment rather than just reports and models. This will encourage partners and stakeholders to take ownership of flood risk and commit the delivery and maintenance of the options laid out in the action plan; and
- Report any wider implications relating to the issues found during this study that fall outside the remit of the SWMP.

1.3.3 Relationship to Other Plans

It is important that the SWMP is not viewed in isolation but in conjunction with other relevant strategic and local plans, as detailed below.

Regional Flood Risk Assessment (RFRA) 2018[6]

The Greater London Authority (GLA) as the regional planning body worked closely with the Environment Agency, Transport for London (TfL), London Resilience and TW to update the RFRA in order to support the London Plan. The document provides a regional understanding of flood risk across Greater London from all sources with a focus on areas identified for major development. It includes monitoring recommendations to ensure broad flood mitigation measures are developed and incorporated into those schemes.

Publication London Plan 2020[7]

This document is an update to the London Plan (2016) which sets out the overall development strategy for London over the next 20-25 years. It sets up an integrated economic, environmental, transport and social framework supported by detailed regulations. On Flood Risk, Policy SI12 and Policy SI13 recommends that current and future flood risk across London should be managed in a sustainable and effective way, as a collaborative effort between developers, local authorities, the Environment Agency and Thames Water (TW). Natural Flood Management (NFM) and Sustainable Drainage Systems (SuDS) should be prioritised and explored following the hierarchy listed in Policy SI13.

Thames Catchment Flood Management Plan (CFMP) 2009[8]

This document details policies for the sustainable management of flood risk across the River Thames catchment over the long-term (50 to 100 year) taking climate change into account. The plan emphasises the role of the floodplain as an important asset for the management of flood risk.

The Thames CFMP highlights that urban areas such as LBL are susceptible to rapid flooding during storm events and appropriate emergency response and flood awareness are required. This is exacerbated by ageing drainage infrastructure, increased development leading to increased impermeable area and climate change (i.e. wetter winters and heavier summer rainfall).

Long-term adaptation of the urban environment within LBL is required. This needs to include:

- Reducing flood risk through redevelopment. which must be resilient and resistant to flooding and result in a layout that recreates river corridors that reduce the consequence of flooding; and
- Identifying opportunities to open up culverts so that there is space for rivers to flow more naturally and for flood waters to be attenuated in the floodplain.

Thames Water Drainage and Wastewater Management Plan (DWMP) 2022[9]

The DWMP is similar to the SWMP, although it focuses on the management of Thames Water assets such as sewers and includes their combined systems. The DWMP outlines how wastewater and drainage issues will be managed with consideration for the impacts of climate change and population growth. The DWMP covers the entire Thames Water catchment and will be available for consultation by 2022.

Preliminary Flood Risk Assessment (PFRA) 2009[10]

According to the PFRA for the LBL, the Borough has experienced several surface water flood events with latest incidents in 2004 (Herne Hill, Streatham Hill, Dulwich and Brixton areas),

[6] Greater London Authority, London Regional Flood Risk Appraisal, September 2018
[7] Greater London Authority, Publication London Plan, December 2020
[8] Environment Agency, Thames Catchment Flood Management Plan, December 2009
[9] Thames Water, Creating Resilient Wastewater Catchments. Available at: https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management
[10] London Borough of Lambeth, Drain London - London Borough of Lambeth Preliminary Flood Risk Assessment, June 2011

2005 (Stockwell and Oval) and 2007 (railway infrastructure was affected but no records of impacts to properties). The 2011 SWMP was written in conjunction with the PFRA and was purposed to present the surface water flood risk information for the LBL. The PFRA therefore refers to the 2011 SWMP for its surface water flood risk section. The PFRA presents flood risk information from all other sources.

Neighbouring Surface Water Management Plans (SWMPs)

Information from neighbouring SWMPs should be used in conjunction with this SWMP to create effective cross-boundary surface water management. This is particularly important where identified CDAs cross borough boundaries. The neighbouring boroughs include the London Borough of Wandsworth (LBW), London Borough of Southwark (LBS), London Borough of Merton (LBM) and London Borough of Croydon (LBC. Each borough will be optimising their action plan in collaboration with the relevant Risk Management Authorities (RMAs). Data and policy interventions from those action plans can feed directly into the operational departments at LBL, particularly those associated with spatial and emergency planning.

Strategic Flood Risk Assessment (SFRA) 2013[11]

Under the NPPF[12] and associated Planning Practice Guidance (PPG)[13] for Flood Risk and Coastal Change LPAs are required to produce an SFRA. This is to ensure flood risk is understood and managed effectively and sustainable throughout all stages of the planning process. Local Plans supported by the SFRA should be used by the LPA to inform strategic land use planning. SFRAs often have an emphasis on fluvial and tidal flooding and hence this updated SWMP will help supplement any information gaps. The most recent Strategic Flood Risk Assessment for Lambeth was completed in 2013.

Local Flood Risk Management Strategy (LFRMS) 2018[14]

The Flood and Water Management Act 2010 requires each LLFA to produce a LFRMS. The SWMP and PFRA provide the necessary evidence base to support development of this document.

River Basin Management Plan (RBMP) 2015[15]

The River Basin Management Plan for the Thames Basin District addresses the pressures facing the water environment in the district and the actions required to protect and improve the water environment. The plan was developed in consultation with a wide range of organisations and individuals. The Thames RBMP is updated on a 6-year cycle, with the latest revision issued in 2015.

Local Development Scheme (LDS) 2019[16]

The Local Development Scheme (LDS) published in 2019 is the programme for preparation of LBL's Local Plan and other planning policy documents. The Local Plan is the statutory development plan for the Borough. It includes the Core Strategy and relevant Area Action Plans (AAPs) which reflect the outputs of the SWMP and other flood risk plans mentioned above. Policies range from borough-wide, area specific (e.g. CDAs) or cross-borough. There may be a need to review AAPs if surface water flood risk is identified as an issue in particular areas as an outcome of the updated Lambeth SWMP.

[11] London Borough of Lambeth, Strategic Flood Risk Assessment, March 2013.
[12] Department for Communities and Local Government (DCLG), National Planning Policy Framework, 2019. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2
[13] DCLG, Planning Practice Guidance: Flood Risk and Coastal Change, 2014. Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change
[14] London Borough of Lambeth, Lambeth Local Flood Risk Management Strategy 2014-2020, October 2018.
[15] Environment Agency, Thames River Basin District River Basin Management Plan, December 2015.
[16] London Borough of Lambeth, Lambeth Local Development Scheme, October 2019.

1.4 Study Area

1.4.1 Topography and Land Use

As described in the 2011 SWMP, the study area is defined by the administrative boundary of the LBL, which is an inner London borough covering an area of approximately 27km^2. The LBL is bordered by the River Thames to the north, the LBS to the east, the LBC to the south and LBM and LBW to the west.

The study area is characterised by a basin of low lying, relatively flat land to the north of the A2217 with undulating land rising away to the south, as shown in Figure 2. The underlying bedrock geology is London Clay, which is overlaid by superficial deposits across much of the study area (River Terrace Deposits), particularly in the north adjacent to the Thames.

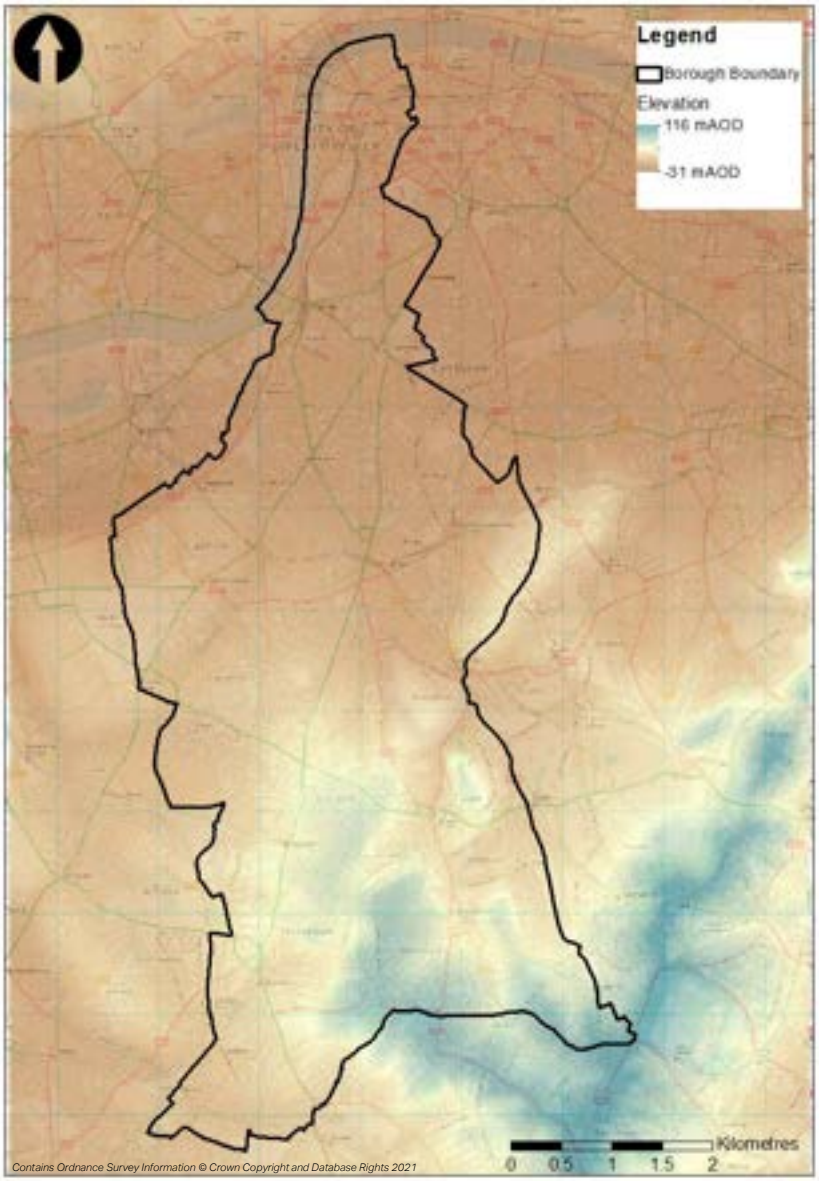


Figure 2 Topography across the London Borough of Lambeth (0.5m DTM LiDAR)

The Borough is heavily urbanised and includes the districts of Waterloo, South Bank, Vauxhall, Oval, Kennington, Stockwell, Clapham, Brixton, Seven Bridges, Herne Hill, Streatham, Tulse

Hill, West Norwood and Gypsy Hill. Areas of open space include Kennington Park, Clapham Common and Brockwell Park. A 1km stretch of the River Graveney, runs through the south-west of the Borough, joining the River Wandle in Colliers Wood. The watercourse is canalised throughout the study area.

LBL is strategically linked on a local, regional and national scale through road, rail and London Underground links. Waterloo Station, located in the north-east of the Borough, is the UK's busiest rail station with 92.4 million entries and exits in the year of 2018-2019 and links LBL to south and south-west England. Adjacent to Waterloo Station is Waterloo East Station with direct links to Charing Cross and London Bridge stations. LBL is served by five London Underground lines. LBL also contains a vast road network including a stretch of the Transport for London Road Network (TLRN) otherwise referred to as "red route". Red route roads are part of a network of London's major roads (carrying 30% of London's traffic) and include the A3 Clapham Road, A23 Brixton Road, A24 Clapham Common South Side, A203 South Lambeth Road and A205 (various names).

The study area falls into the Thames River Basin District (RBD) and is located in the Environment Agency Thames Region. The sole water utility provider is TW.

1.4.2 Flood Risk Overview

The Environment Agency Long-Term Flood Risk Mapping[17] and the 2011 SWMP[18] both highlight main surface water runoff routes flowing from the southern part of the LBL towards the north and the River Thames.

The 2011 SWMP highlighted the most significant surface water flooding are in natural topographical valleys following the course of old rivers which are now culverted such as the River Effra. This flow path leads to significant ponding in Norwood, West Dulwich, Herne Hill, Brixton and Kennington, which match historical flood records.

The SWMP also identified three areas most at risk to surface water flooding due to the combined influence of pluvial, groundwater and sewer flooding. These areas are Dulwich Road, Railton Road, Herne Hill, Clapham and Streatham.

The last recorded significant surface water flood event in LBL occurred in 2004 affecting the Herne Hill and Dulwich Road area. Flooding was attributed to the intensity of the rainstorm which was reportedly a 1 in 300 year flood event (0.3% AEP). Local topography caused runoff to accumulate in low-lying areas which compounded flooding associated with the surcharging TW sewer network.

United Kingdom Climate Projections 2018 (UKCP18)[19], predict that by 2070, the extreme hourly rainfall intensity associated with an event that occurs typically once every 2 years (50% AEP) is projected to increase by 25% (Central Estimate).

Average winter precipitation will increase by up to 35% whereas summer precipitation will decrease by up to 47%. The intensity of summer storms is also set to increase, which will have an impact on the frequency and severity of surface water flooding.

[17] Environment Agency, Long-Term Flood Risk Mapping. Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk . Accessed April 2020.
[18] London Borough of Lambeth, Surface Water Management Plan – Drain London -Lambeth, September 2011.
[19] Met Office, UK Climate Projections, 2019. Available at: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index

2. Phase 1: Preparation

2.1 Lambeth SWMP (2011)

The 2011 SWMP[18] was undertaken as part of the Drain London project led by the Greater London Authority (GLA). This was the first SWMP for the Borough, meeting LBL's duties as LLFRA under the Flood and Water Management Act 2010. This study was undertaken in conjunction with the LBS, through the South-Central London Strategic Flood Group. This allowed the neighbouring boroughs to pool best practice and resources.

The 2011 SWMP undertook an intermediate assessment to establish an understanding of surface water flooding mechanisms across the Borough and identify flooding hotspots. Fourteen CDAs were identified, a number of which were cross-boundary between LBL and neighbouring boroughs.

This intermediate assessment used direct rainfall modelling across the local catchments within the LBL and LBS. This modelling represented the 2D flow across the catchment surface only, with a constant loss rate applied to approximate the capacity of the sewer system.

The main surface water flooding mechanisms and areas most at risk were:

- Along the route of the River Effra, which runs south to north through the Borough, through Herne Hill and Brixton.;
- In the West Dulwich and Herne Hill areas where correlation was found between historical flood records and the surface water modelling;
- In Nine Elms, Streatham, Clapham South and East Norwood where significant ponding of surface water, over 0.5m, was predicted; and,
- In Herne Hill, Brixton and Norwood where flooding appeared to be due to flows originating from the LBS and LBC, highlighting the importance of managing flood risk at a catchment scale across borough boundaries.

Historical records presented in the 2011 SWMP indicated that flooding was largely a result of limited capacity within the local drainage network and the TW sewer network. The Borough is mainly served by a combined system, largely built in the late 1800s which has not kept pace with development in LBL.

2.2 Requirement for an SWMP Update

The 2011 SWMP hydraulic modelling omitted the interaction of below-ground drainage infrastructure including culverted watercourses, combined and surface water sewers. Given the heavily urbanised nature of LBL, will significantly influence surface water flood risk mechanisms.

The 2011 SWMP also suggested the use of SuDS as "source" and "pathway" measures to be considered as borough-wide options but did not provide specific locations or hydraulic catchments where they would be most effective. In addition, the 2011 SWMP's mitigation options only focused on receptor level measures in close proximity to at-risk locations.

It is therefore necessary to update the SWMP to provide an evidence-based approach to the incorporation of flood management within the future development of the LBL. Updated modelling outputs will help refine the legacy CDAs. The updated SWMP will also develop and expand the existing concepts of source and pathway management by being more descriptive on the suitable locations or catchments where they would be most effective.

The proceeding sections describe the detailed modelling exercises undertaken since the 2011 study and which have been used to inform the updated Lambeth SWMP Model.

2.3 Previous Modelling Studies

2.3.1 Background

Since the 2011 SWMP there has been several modelling studies to assess the feasibility and benefits of new flood mitigation schemes. These schemes have incorporated updated sewer network data, topography and building infrastructure as well as the utilisation of new modelling capabilities such as an integrated 1D/2D approach. The modelling used to inform the 2011 SWMP was based on the representation of 2D overland flow only. Since 2011, much of the surface water modelling in central London incorporated the TW 1D model of the sewer network.

2.3.2 Thames Water Crossness Strategic & Detailed Modelling

The TW 1D Crossness Wastewater Thames Network model covering large parts of south London. The detailed version of the model which includes trunk mains, manholes, inflows and outflows, was provided for the study area.

2.3.3 Detailed Modelling Studies

There have been several modelling studies within the Borough since 2011. These are summarised in Table 2 below.

Table 2 History of Detailed Surface Water Modelling within the London Borough of Lambeth

Model	Date	Ownership	Description	Software
Brockwell Park Catchment Model 2016	2016	London Borough of Lambeth	1D-2D integrated catchment model of Brockwell Park	InfoWorks ICM
Norwood Cemetery MicroDrainage	2017	London Borough of Lambeth	1D local drainage network within Norwood Cemetery	InfoWorks MicroDrainage
Brixton CDA Model 2020	2020	London Borough of Lambeth	1D-2D integrated catchment model of the Brixton CDA (Group7_033)	InfoWorks ICM

This SWMP study built on the above modelling where appropriate to create a borough-wide detailed model (updated Lambeth SWMP Model). The original CDA designations were then revised as appropriate to inform the SWMP action plan. This process is discussed in Phase 2: Risk Assessment.

2.4 Partnerships

2.4.1 Who should be involved

A partnership approach is the most effective way to co-ordinate flood risk management given the complexity of surface water flood risk. There are three key partners who were involved and proactively engage throughout the study:

1. London Borough of Lambeth as LFFA, which includes the relevant internal highways, housing, parks, spatial and emergency planning teams;
2. The Environment Agency; and

3. Thames Water Utilities Ltd.

The London Boroughs of Wandsworth, Southwark and Croydon were engaged with to discuss flood risk management opportunities for cross-borough CDAs.

Several stakeholders are affected by decisions made by the partnership. These include, but are not limited to:

- The public;
- The local National Flood Forum;
- Riparian owners;
- Developers;
- TfL;
- Lambeth Borough Council Highways Authority;
- Local Community Groups, and;
- The Thames Flood and Coastal Committee (RFCC).

These stakeholders were not directly engaged during development of the 2021 SWMP The LBL will liaise directly with these stakeholders later, as the SWMP Action Plan is put into execution, to discuss constraints and opportunities associated with each of them.

2.4.2 Roles & Responsibilities

The roles of the key partners are given below.

1. **Local Authority**

   As the lead partner, the LBL is responsible for ensuring that all objectives are set and met and that a partnership approach is adopted. It is also responsible for leading the production of the SWMP.

2. **Thames Water**

   Responsible for sewage services within the SWMP area, TW provided data on all TW assets within the study area. Due to the urban nature of the catchment, extensive drainage infrastructure and the direct impact this has on the level of surface water flood risk this partnership has been essential to improving understanding of surface water flood risk in the LBL.

3. **Environment Agency**

   The EA has an operational role with the responsibility for formal flood defences, any river structures, developmental control and water quality requirements. It also has a strategic overview for all sources of flooding and hence has an interest in supporting the SWMP through the provision of tools, guidance and data.

2.5 Scope of the SWMP

2.5.1 Set Objectives

The aim of the SWMP is to identify sustainable management responses to surface water flooding. This was achieved through the following methodology:

1. Updated modelling and mapping of surface water flood risk;
2. Identifying areas at higher risk of surface water flooding within the Borough, and define the catchments leading to those CDAs;
3. Understanding the consequences of existing and future surface water flooding for each CDA through CDA-specific damage assessments;

4. Identifying effective, affordable, achievable and cost-beneficial measures to mitigate surface water flood risk in each CDA whilst achieving multiple benefits where possible;
5. Developing a borough-wide strategy to inform holistic planning of drainage design in large new developments;
6. Developing a plan to show how partners and stakeholders can work together to finance and implement this strategy, and;
7. Reviewing the plan to monitor the effectiveness of chosen solutions.

Where possible the SWMP should seek to align with other plans and investment activities occurring locally to help reduce costs and disruption to the area. In the LBL this includes:

- Highway re-development schemes which may present opportunities to improve the highway drainage by incorporating SuDS and green infrastructure into the design;
- Schemes to improve water quality or that address the structural deficiency in drainage systems;
- Refurbishment of public green space creating public amenity and biodiversity improvements and enabling the introduction of flood storage;
- Major development projects which may provide opportunities for new drainage, surface water storage and SuDS, and;
- SuDS retrofit in existing drainage areas helping to alleviate localised surface water flooding such as from combined sewer overflows.

2.5.2 Engagement Plan

Stakeholder engagement has been undertaken during preparation of the updated SWMP study. Stakeholders are more likely to be receptive to proposed mitigation measures if there has been ongoing engagement and transparency throughout the options development process. Early engagement can also help manage expectations. The following engagement activities were organised:

- Undertake a stakeholder assessment between the identified partners to confirm each party's desired outcomes;
- Discuss the options identified with stakeholders to confirm their feasibility; and
- Present the outcomes of the updated SWMP study to all stakeholders so that each can take the necessary action to reduce to the impact of surface water flooding,

2.5.3 Available Information

Table 3 below outlines the data required to update the SWMP study.

Table 3 Data Sources

Type	Source	Format	Requirement
Foul, combined & sewer network model	TW	InfoWorks ICM	Used to define the 1D network in the updated SWMP modelling
Critical drainage asset data	TW	Excel	Used to identify critical assets within the TW 1D network.
OS Mapping Data	LBL has a licence for this data	GIS	Used for background mapping
Digital Terrain Data	DEFRA data services platform	LiDAR	Defined flood flow routes in the 2D domain
Historic flood incident data	LBL	Database	Used to understand where and why historical flood incidents occurred
Catchment Descriptors	FEH[20]	Database	Catchment descriptors were used to generate rainfall profiles used as input into the modelling to run simulations of flood events
Strategic Flood Risk Assessment	LBL	Report & mapping	Used to understand flood risk across the LBL and flood risk mitigation measures expected from developers. Last updated 2013.

2.5.4 Data Limitations

The sewer network represented in the updated Lambeth SWMP Model is based on the supplied TW Detailed Sewer Network and TW Crossness Strategic Model. In order to maintain reasonable model simulation durations, the TW Detailed Sewer Network was only used within the updated Lambeth SWMP Model 2D extents and the TW Crossness Strategic Model was retained to represent the wider South London network and connections to the outfalls. The two models were therefore merged which highlighted some misconnections between the two sets of TW data. These areas of the network were reconnected based on appropriate assumptions made from the surrounding elevation, pipe dimension and direction of flow.

2.5.5 High Level Assessment

A high-level assessment of surface water flood risk identified “local” flood hotspots (SWHZs) which are likely to be at greater risk of surface water flooding and enabled the designation of CDAs. The methodology used to define the CDAs is detailed in the CDA Delineation Methodology Technical Note[21] attached in Appendix A.

A detailed assessment was then undertaken for those identified areas to gain a detailed understanding of the causes and consequences of surface water flooding and assess the potential benefits of flood mitigation measures. The updated surface water modelling undertaken as part of the SWMP was used to inform the detailed assessments. A detailed description of the modelling approach is provided in the Lambeth Hydraulic Modelling Model Build Report[22], attached in Appendix B.

[20] UK Centre for Ecology and Hydrology, Flood Estimation Handbook Web-service. Accessible on: https://fehweb.ceh.ac.uk/ . Accessed January 2018.
[21] AECOM, CDA Delineation Methodology – Technical Note, April 2021.
[22] AECOM, Lambeth Hydraulic Modelling Model Build Report, April 2021.

3. Phase 2: Risk Assessment

3.1 Borough-Level Current and Future Flood Risk

The updated Lambeth SWMP builds on the results of the 2011 SWMP by improving the understanding of flood mechanisms within the LBL through a detailed assessment of surface water flood risk.

A detailed model for the existing Brixton CDA developed in 2020 was already held by LBL. To support the updated SWMP, LBL commissioned the extension of the existing Brixton CDA model to cover the entire hydraulic catchment within the Borough. This was designed to allow detailed assessment using a catchment-wide 1D-2D hydraulic model. Details on the updated Lambeth SWMP modelling methodology can be found in the Updated Lambeth SWMP Model Build Report[22].

3.1.1 Present Day Flood Risk

Results showing flood depth, flow velocity and hazard rating for the 1% AEP are presented in Figure 4, Figure 5 and Figure 6. Results for the 50%, 5%, 3.3%, 3.3% plus 40% climate change allowance, 1.3%, 1%, 1% plus 40% climate change allowance, 0.5% and 0.1% AEPs are presented in Appendix C.

Results show that areas with the highest density of properties at risk of flooding) are concentrated in the north of the Borough and the Herne Hill area. Table 4 presents the differences in maximum flood depth and total flooded areas for each of the return periods assessed above, including the climate change allowance.

Table 4 Comparison of maximum flood depth and total areas at risk of flooding

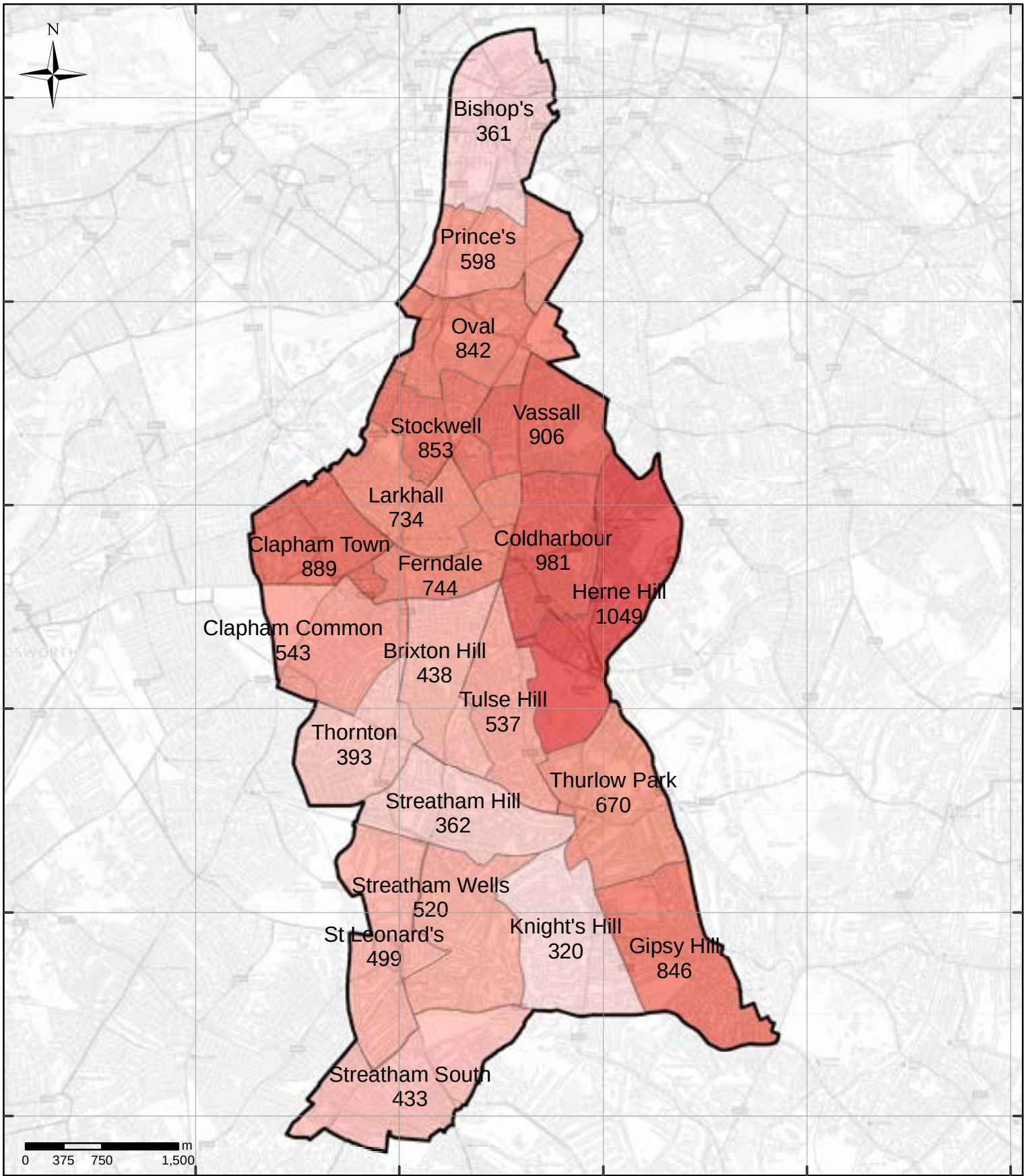
Model Results	3.3% AEP	1% AEP	1% AEP + CC	0.1% AEP
Maximum Flood Depth (m)	3.442	4.23	4.46	4.51
Change in Flood Depth	-	0.78m (23%)	1.02m (29%)	1.07m (31%)
Total Flooded Area (km^2) Depth > 0.1m	2.52	4.03	5.97	8.22
Change in Flooded Area (km^2)	-	1.51 (60%)	3.45 (137%)	5.70 (226%)

Table 5 presents the numbers of residential properties at high (3.3% AEP), medium (1% AEP) and low (0.1% AEP) risk of flooding within each LBL ward. Figure 7 shows a comparison between the high, medium and low risk flood extents. Tables including results for commercial properties and infrastructure can be found in Appendix D.

Table 5 Residential Properties at Risk of Flooding in the London Borough of Lambeth, by Ward

Ward Name	Ward Area (ha)	Average Density of Flooded Properties (1% AEP)	Number of Residential Properties at Risk of Flooding		
			High Risk (3.3% AEP)	Medium Risk (1% AEP)	Low Risk (0.1% AEP)
Stockwell	86.3	9.9	437	853	1,466
Ferndale	85.2	8.7	553	744	1,252
Coldharbour	121	8.1	608	981	1,818
Vassall	112.8	8.0	570	906	1,681
Clapham Town	111.9	7.9	606	889	1,294
Larkhall	106.3	6.9	509	734	1,278
Oval	127.9	6.6	453	842	1,860
Gipsy Hill	157	5.4	654	846	1,240
Herne Hill	202.7	5.2	711	1,049	1,717
Tulse Hill	103.1	5.2	358	537	870
Prince's	116.3	5.1	321	598	1,200
Thurlow Park	151.1	4.4	399	670	1,120
Clapham Common	133.9	4.1	389	543	858
Brixton Hill	112.9	3.9	269	438	740
Streatham Wells	145	3.6	396	520	854
Thornton	107.8	3.6	265	393	722
St Leonard's	144.6	3.5	364	499	783
Streatham Hill	127.3	2.8	271	362	638
Streatham South	169.9	2.5	267	433	955
Bishop's	153.9	2.3	209	361	597
Knight's Hill	146.8	2.2	237	320	465
Total			**8,846**	**13,518**	**23,408**

Figure 3 shows the distribution of residential properties at medium risk of flooding across the wards.



Legend

- Borough Boundary
- Ward Boundary

Residential Properties at Risk (Numbers per ward)

High : 1049

Low : 320

Notes:

1. This map illustrates the number of residential properties at risk of incurring damages by ward within the London Borough of Lambeth during a 1% AEP event as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The accompanying Model Build Report and SWMP should be read in conjunction with this map to better understand the accuracy and limitations of the property counts shown.
3. This map provides an overview of the impact of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title: **Residential properties at risk of flooding within the London Borough of Lambeth by ward, for the 1% AEP**

Purpose of Issue: For Issue

Client: London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

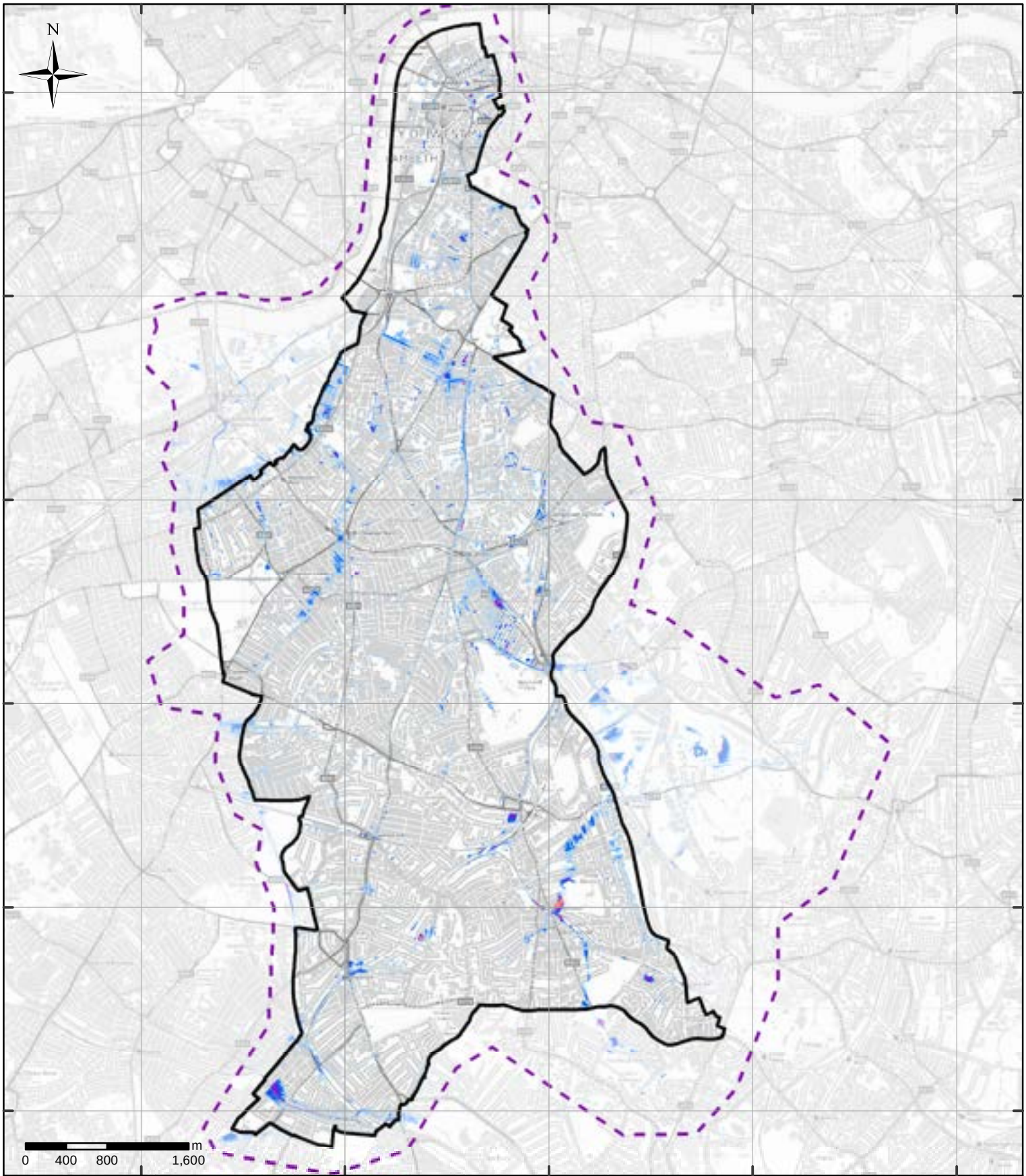
Project Title: London Borough of Lambeth Surface Water Management Plan

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Figure 3



Legend

- Model Extent
- Borough Boundary

Modelled Maximum Flood Depth (m):

- < 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- > 1.50

Notes:

1. This map illustrates the likelihood of surface water flooding as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The accompanying Model Build Report should be read in conjunction with this map to better understand the accuracy and limitations of the flood extents and depths shown.
3. This map provides an overview of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title

Flood depths for 1% AEP across the London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

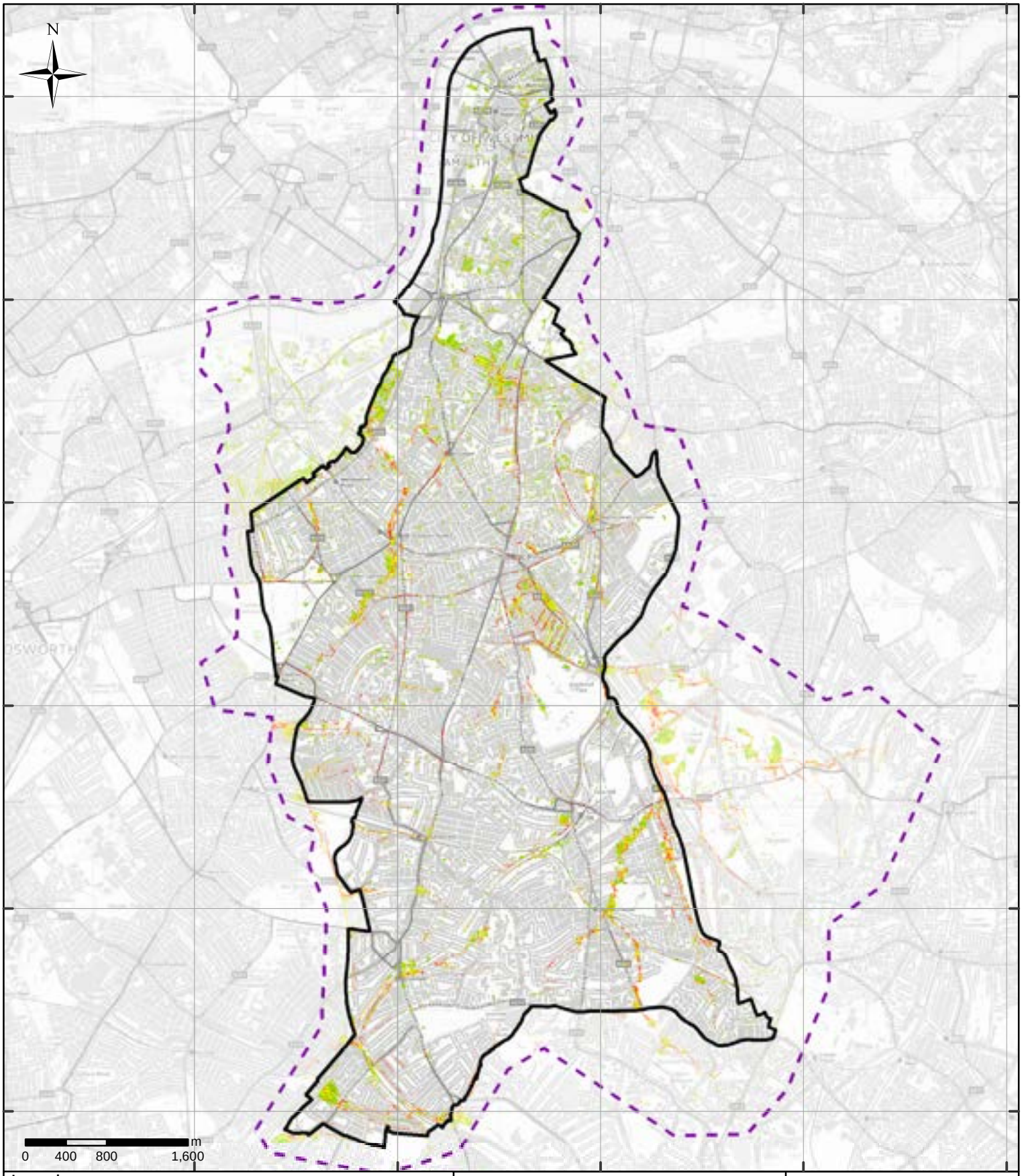
Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 4



Legend

- Model Extent
- Borough Boundary

Modelled Maximum Flood Velocity (m/s):

- 0 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- >0.50

Notes:

1. This map illustrates the likely surface water flow velocities as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The accompanying Model Build Report should be read in conjunction with this map to better understand the accuracy and limitations of the flood extents and velocities shown.
3. This map provides an overview of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title

Flow velocities for the 1% AEP for the London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

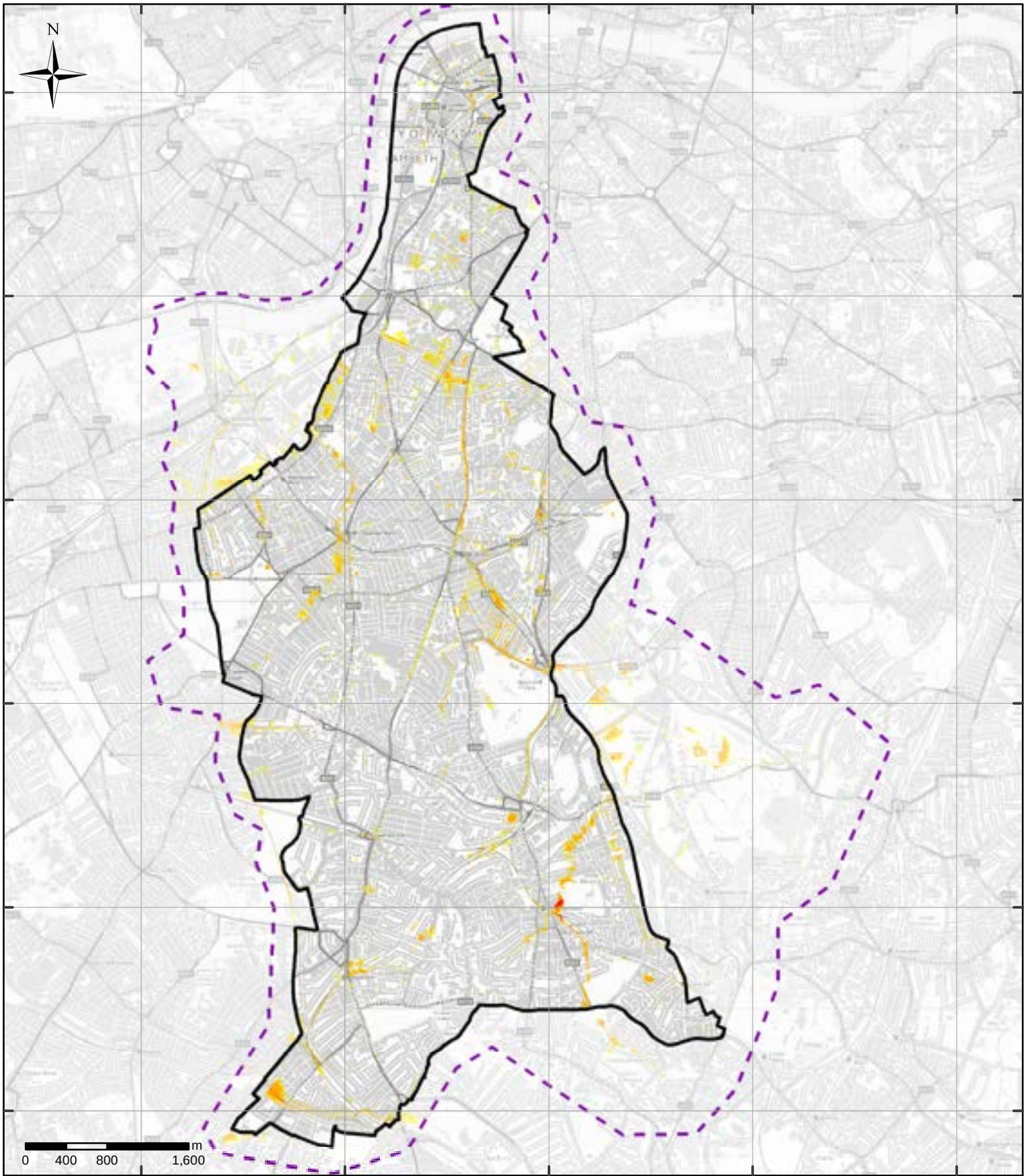
Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 5



Legend

- Model Extent
- Borough Boundary

Modelled Maximum Flood Hazard:

<0.75	Very Low Hazard
0.75-1.25	Danger for Some
1.25-2	Danger for Most
>2	Danger for All

Notes:
1. This map illustrates the likelihood of surface water flooding as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The accompanying Model Build Report should be read in conjunction with this map to better understand the accuracy and limitations of the flood extents and hazards shown.
3. This map provides an overview of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title

Hazard ratings for the 1% AEP for the London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

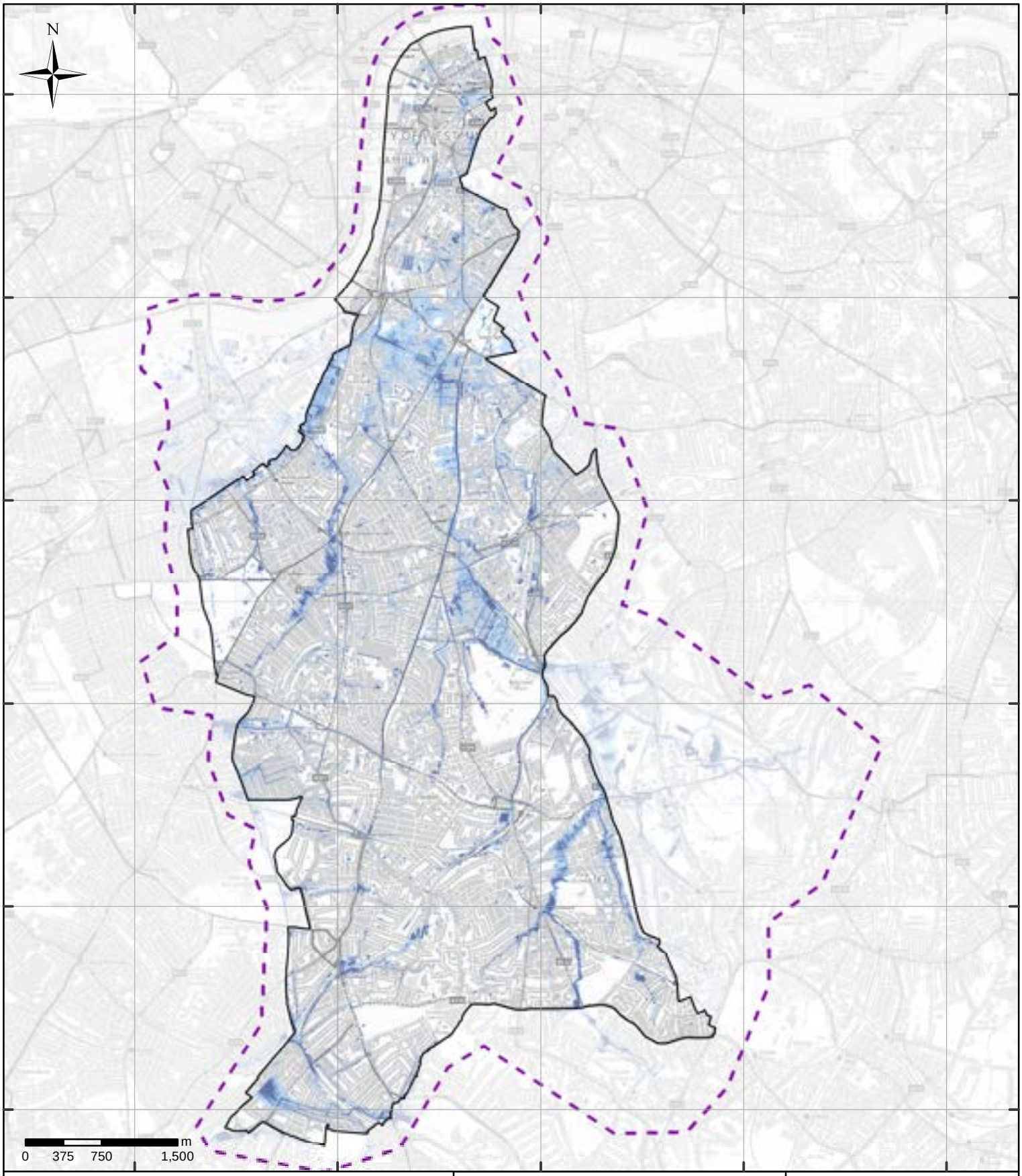
Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 6



Legend

- Model Extent
- Borough Boundary
- 3.33% AEP Flooding Extent (High Risk of Flooding)
- 1% AEP Flooding Extent (Medium Risk of Flooding)
- 0.1% AEP Flooding Extent (Low Risk of Flooding)

Notes:
1. This map illustrates the likelihood of surface water flooding as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The accompanying Model Build Report should be read in conjunction with this map to better understand the accuracy and limitations of the flood extents shown.
3. This map provides an overview of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title
Modelled maximum flood extents for high, medium and low risk across the London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 7

3.1.2 Future Flood Risk

Examining future risk is important to understand how risk changes over time. In the future the level of flood risk is expected to change in line with urban creep, population growth and climate change. LBL is largely brownfield development where opportunities to reduce surface water runoff by redesigning the urban landscape to make sufficient space for surface water should be maximised.

Key guidance on how to calculate gross storage requirements to achieve runoff volume control from new development can be found in the Environment Agency/Defra publication 'Preliminary rainfall runoff management for developments'[23]. The Lambeth Local Plan sets out planning policies to guide growth in housing and jobs, infrastructure and the quality of the built environment up until 2030. The mapping produced as an outcome of this study can be used as an evidence base to support future spatial planning to ensure that surface water flooding and the impacts from climate change are appropriately considered when allocating land for development.

Adopted Local Plans[24] identify key Opportunity Areas where development and regeneration are most needed. The Local Plan also addresses current transportation issues, regeneration and classification of centres and provision of more housing in appropriate locations whilst maintaining the balance and diversity of neighbouring residential areas.

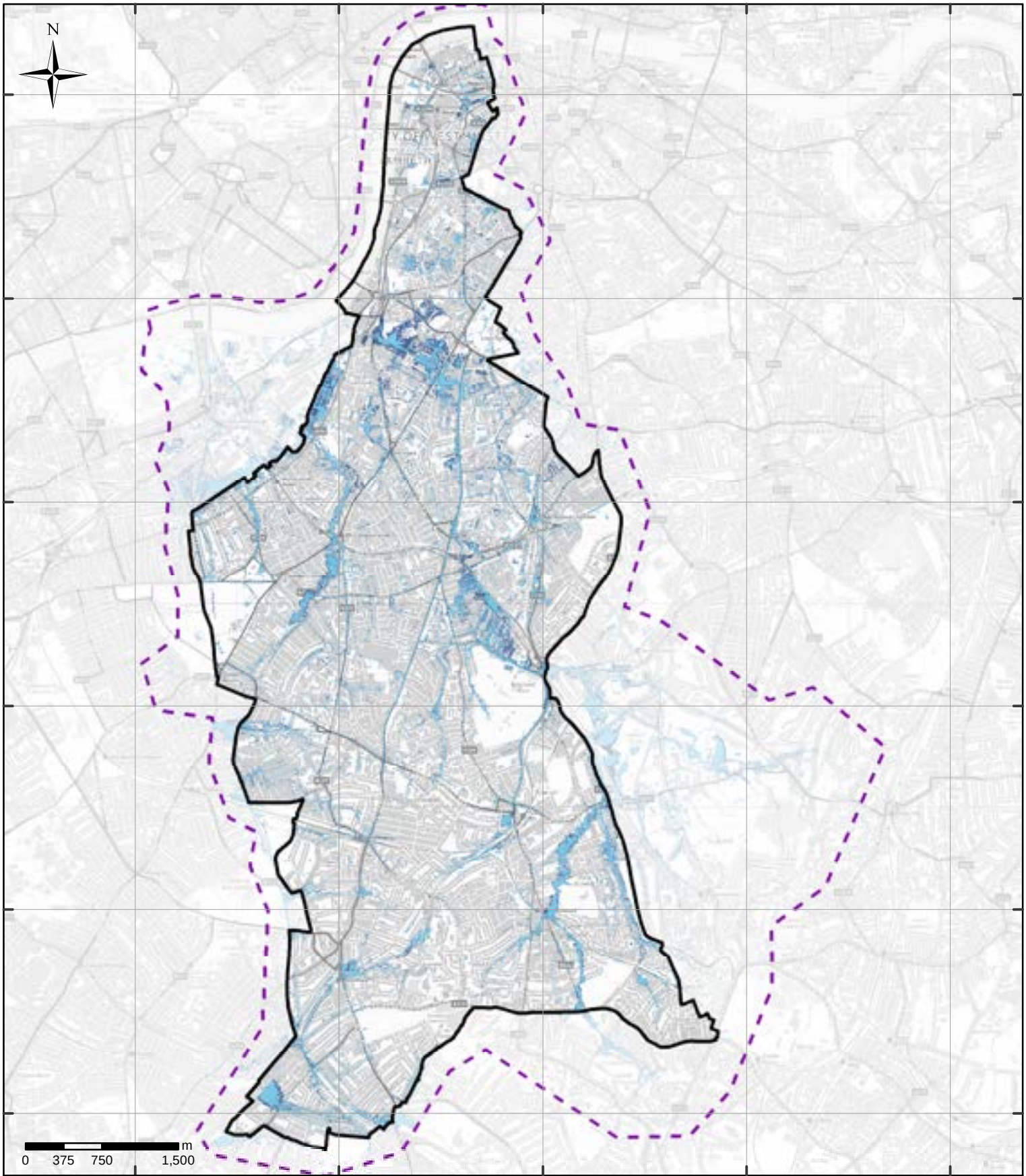
The Key Strategic Objectives of Local Plans are to help tackle some of the challenges faced during urban development. Mirroring national planning policy and assessing flood risk as a material consideration in planning, the Local Plans include SuDS and flood risk management policies. These ensure new development proposals account for sustainable drainage measures to lessen the risk of flooding and impact of climate change. These policies can be addressed through the design of the built environment, retention of existing trees, urban greening and sustainable urban drainage and protection of the supply of water.

The results from the surface water modelling undertaken as part of this updated Lambeth SWMP should be used in line with development planning. This will allow the Borough's priorities on flood risk management to be appropriately informed and translated into planning policies which can then be incorporated into the design.

The modelling undertaken for the updated Lambeth SWMP includes an increase in peak rainfall intensity to represent the impact of climate change on rainfall patterns. As per NPPF guidance[25] on climate change allowances the Upper End estimate for peak rainfall intensity anticipated for the 2080s is 40%. An uplift of 40% on peak rainfall was therefore included for the 3.3% AEP and 1% AEP storm events.

Comparison of model outputs for the 1% AEP and the 1% AEP + 40% CC , as shown in Figure 8, shows a significant increase in areas at risk of flooding with the allowance for climate change, with the greatest increases at the northern end of the Borough (Oval and Wandsworth Road areas). As the sewers are already mostly at capacity (with occasional surcharging) in the 1% AEP, this increase in flood risk with climate change is due to the additional surface water runoff being unable to enter the sewerage system in any part of the catchment. Runoff is therefore conveyed mostly within carriageways following topography, before accumulating in the Borough low points to the north.

[23] DEFRA and Environment Agency Flood and Coastal R&D Programme, Preliminary rainfall runoff management for developments, R&D Technical Report, W5-074/A/TR/1, Revision D, 2005.
[24] Lambeth Borough Council. 2015. *Lambeth Local Plan*. Available at: https://www.lambeth.gov.uk/sites/default/files/pl-lambeth-local-plan-2015-web.pdf
[25] Environment Agency, Flood risk assessments: climate change allowances, 2020. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances



Legend

- Model Extent
- Borough Boundary
- 1% AEP Flooding Extent
- 1% AEP +40% CC Flooding Extent

Notes:
1. This map illustrates the likelihood of surface water flooding as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The accompanying Model Build Report should be read in conjunction with this map to better understand the accuracy and limitations of the flood extents shown.
3. This map provides an overview of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title **Modelled maximum flood extents at present (1% AEP) and in the future (1% AEP + 40% CC) across the London Borough of Lambeth**

Purpose of Issue: For Issue

Client: London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

Project Title: London Borough of Lambeth Surface Water Management Plan

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Figure 8

3.2 CDAs

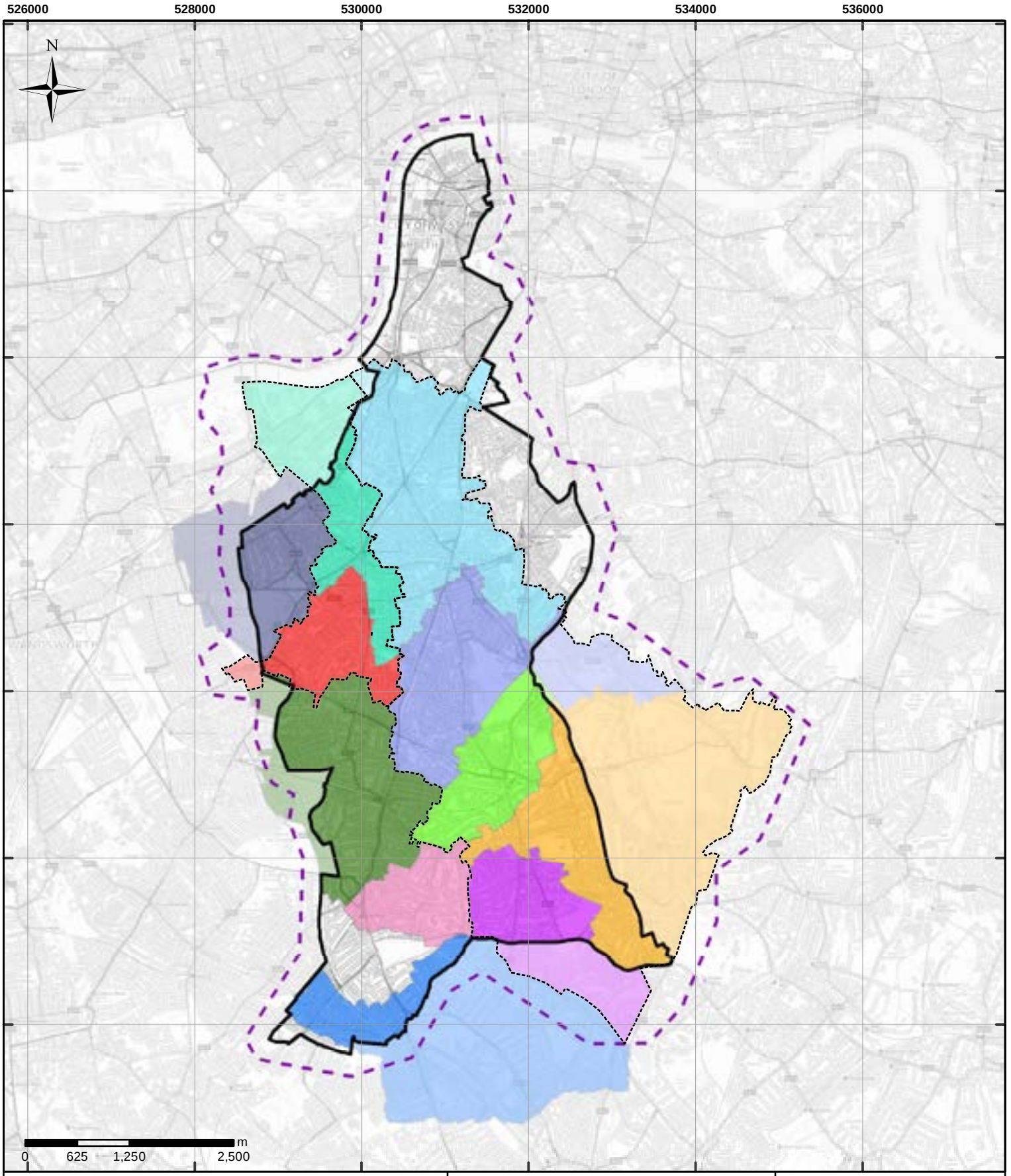
3.2.1 Methodology

SWHZs were defined based on the model outputs for the 1% AEP event. SWHZs represent areas for which flood risk is classified as a Danger for Some, based on both flood depth and velocity. These SWHZs were then used to define 11 CDAs within the Borough. Some CDA boundaries also extended beyond the Borough limits. The CDA Delineation Methodology[21] describes the approach used to identify the CDAs, which are presented in Table 6 and Figure 9.

Table 6 Critical Drainage Areas for the London Borough of Lambeth

CDA Name	London Borough(s)
Clapham CDA	LBL
Oval CDA	LBL
Railton Road CDA	LBL, LBS
South Lambeth CDA	LBL, LBW
Streatham CDA	LBL
Streatham Hills CDA	LBL, LBW
Streatham Vale CDA	LBL, LBC
Tulse Hill CDA	LBL
Wandsworth Road CDA	LBL, LBW
West Dulwich CDA	LBL, LBS
West Norwood CDA	LBL, LBC

A detailed assessment of surface water flood risk was undertaken for each CDA to understand flooding mechanisms. This assessment focuses on the 50% AEP, 3.33% AEP, 1% AEP and 0.1% AEP events. Flooding impacts were quantified through a damage assessment.



Legend

- Model Extent
- Borough Boundary
- Hydraulically connected CDAs

Hydraulically Connected Group 1

- Oval CDA
- Railton Road CDA
- Tulse Hill CDA
- West Dulwich CDA
- West Norwood CDA

Hydraulically Connected Group 2

- Clapham CDA
- South Lambeth CDA

Other

- Streatham CDA
- Streatham Hills CDA
- Streatham Vale CDA
- Wandsworth Road CDA

Notes:

1. This map presents the outlines of the Critical Drainage Areas within Lambeth as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The methodology used to produce these CDAs can be found within the CDA Delineation Technical Note.
3. This map provides the CDAs as informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.
4. The hydraulic connectivity of the CDAs is defined in the updated SWMP. Connected CDAs form two groups as shown in this figure.

Drawing Title: **Critical Drainage Areas for the London Borough of Lambeth**

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:60,000
Scale at A3: 1:42,000
Scale at A1: 1:21,000

Date: 14/05/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 9

3.2.2 Damage Assessment

A property count and damage assessment were undertaken based on the updated Lambeth SWMP model outputs, to provide a quantitative measure to the risks associated with surface water flooding within the Borough. The damage assessment was undertaken for properties with a minimum depth of flooding across the building of 0.2m.

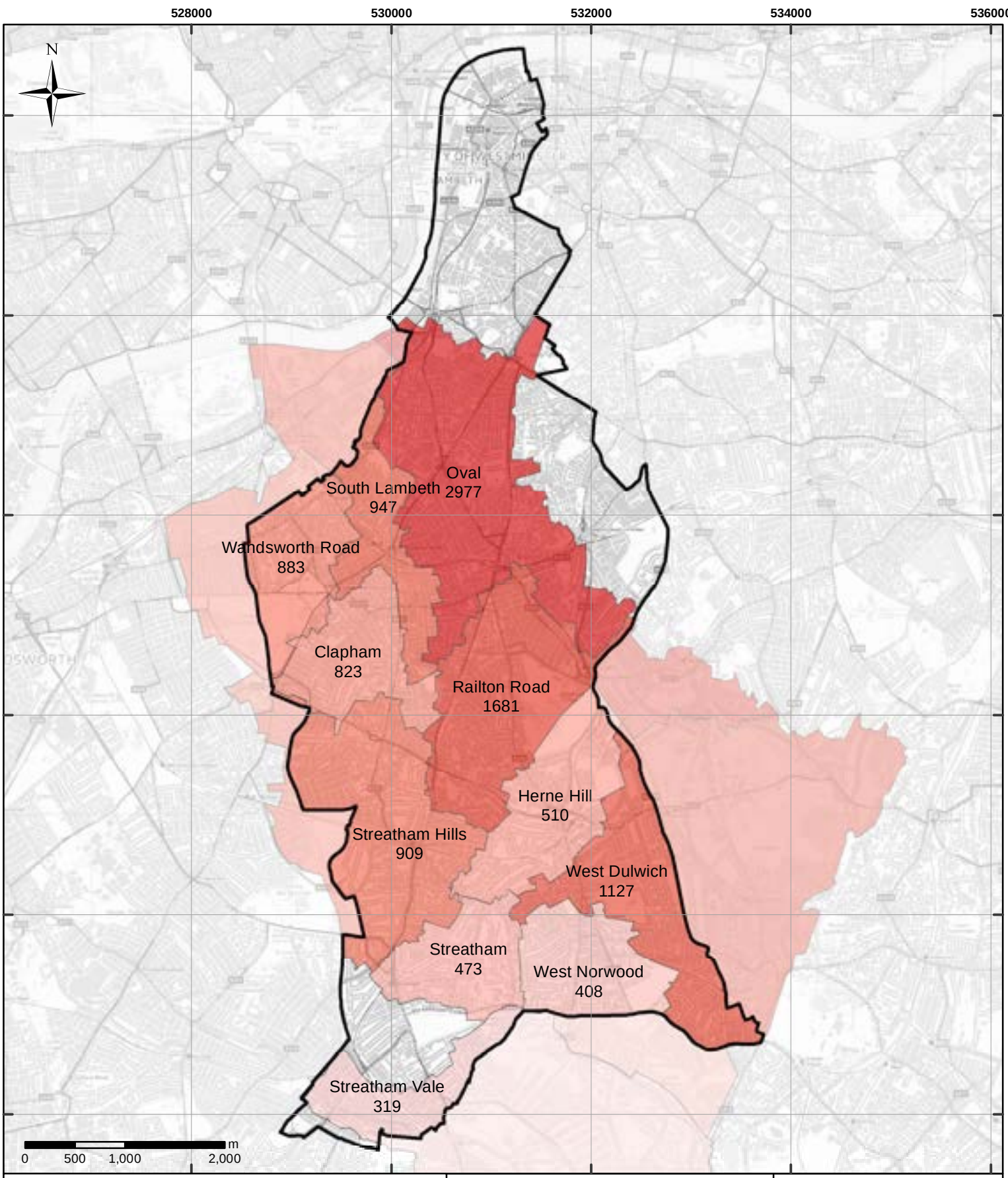
Table 7 presents the numbers of residential properties at high (3.3% AEP), medium (1% AEP) and low (0.1% AEP) risk of flooding within each CDA. Figure 10 shows the distribution of residential properties at medium risk of flooding across the CDAs. Tables including results for commercial properties and infrastructure can be found in Appendix D.

Table 7 Residential Properties at Risk of Flooding in the London Borough of Lambeth, by CDA

CDA Name	CDA Area (ha)	Average Density of Flooded Properties (1% AEP)	Number of Residential Properties at Risk of Flooding		
			High Risk (3.3% AEP)	Medium Risk (1% AEP)	Low Risk (0.1% AEP)
South Lambeth	121.2	7.8	574	947	1,594
Oval	420.3	7.1	1,827	2,977	5,577
Wandsworth Road	132.6	6.7	622	883	1,226
Railton Road	260	6.5	1,032	1,681	2,883
Clapham	138.5	5.9	623	823	1,324
West Dulwich	210	5.4	733	1,127	1,739
Streatham	122.6	3.9	343	473	764
Streatham Vale	101.4	3.2	173	319	754
Streatham Hills	293.4	3.1	638	909	1585
West Norwood	135.8	3.0	331	408	577
Tulse Hill	175.8	2.9	391	510	819
Other			1,559	2,461	4,566
Total			8,846	13,518	23,408

Figure 11 displays the distribution of those damages (all types of properties mixed) across the Borough using a heat-map function (GIS Point Density tool). The resolution at which this assessment has been undertaken cannot identify individual properties and this map shall therefore not be used to that purpose.

The high-level methodology used for this assessment is included in Appendix D.



Legend

- Borough Boundary
- CDA Boundary

Residential Properties at Risk (Numbers per CDA)

High : 2977

Low : 319

Notes:

1. This map illustrates the number of residential properties at risk of incurring damages by CDA within the London Borough of Lambeth during a 1% AEP event as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The accompanying Model Build Report and SWMP should be read in conjunction with this map to better understand the accuracy and limitations of the property counts shown.
3. This map provides an overview of the impacts of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title: **Residential Properties at Risk of Flooding within the London Borough of Lambeth by CDA, for the 1% AEP**

Purpose of Issue: For Issue

Client: London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

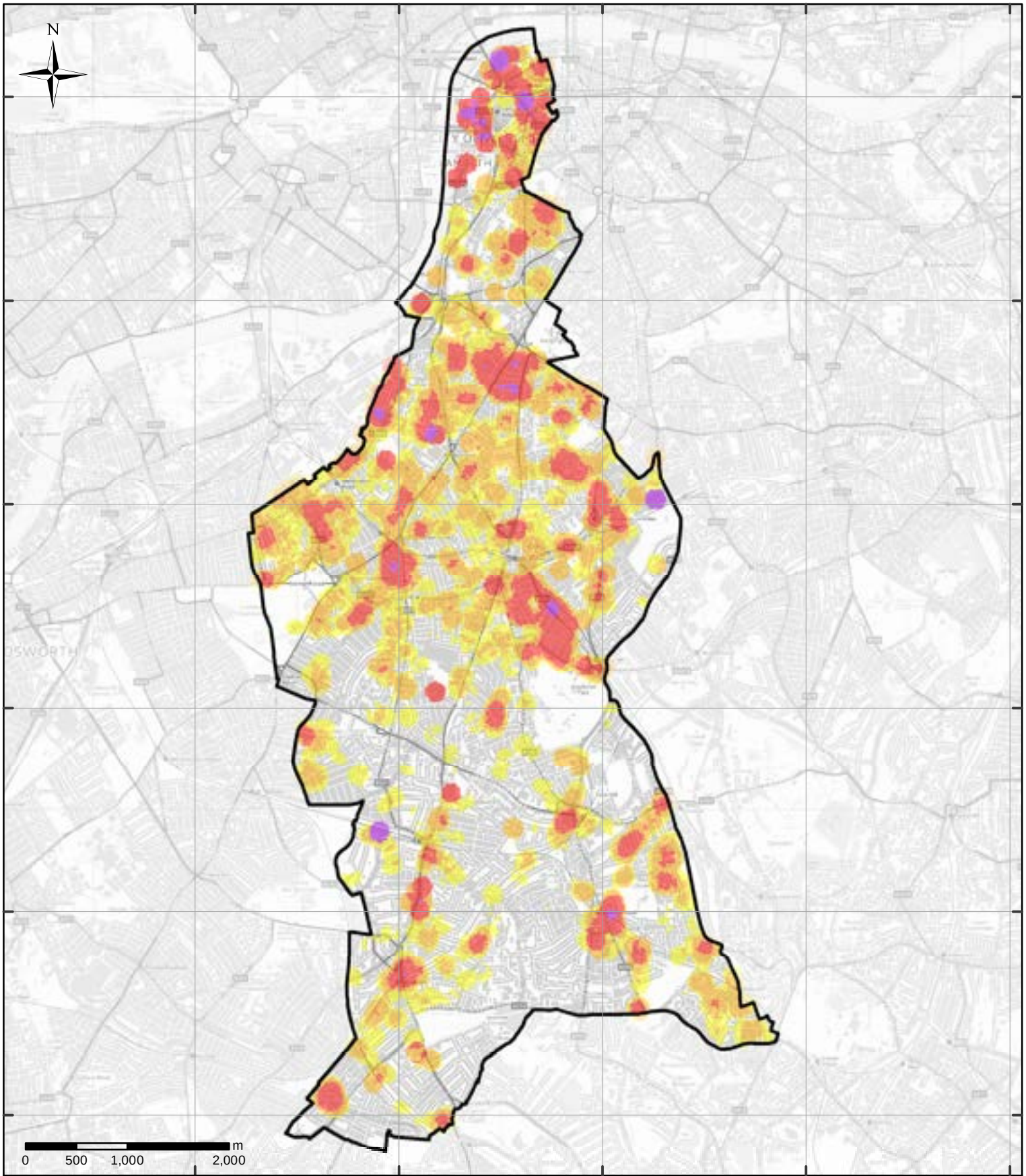
Project Title: London Borough of Lambeth Surface Water Management Plan

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Figure 10



Legend

Borough Boundary

Property Damages (£/km²):

- 0 - 5,000
- 5,000 - 10,000
- 10,000 - 25,000
- 25,000 - 100,000
- > 100,000

Notes:

1. This map presents the estimated property damages within the London Borough of Lambeth based on the 1% AEP updated Lambeth SWMP hydraulic modelling outputs prepared for the London Borough of Lambeth.
2. Property damages were calculated within Lambeth only.
3. The mapping shows property damage value per km² (ie. total damage value within a coloured unit would be the unit's associated damage value multiplied by the unit's area).
4. The methodology used to produce the property damages can be found within the Damages Methodology appended to this SWMP.
5. This map provides the Property Damages as informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title

Distribution of damages within the London Borough of Lambeth for the 1% AEP

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 11

3.2.3 Flooding Mechanisms at CDA Level

A description of flooding mechanisms as well as damage assessment and impact on critical infrastructure is presented for each CDA in the proceeding section.

Figures supporting each description include the following information:

- Flood extents and surcharging gullies based on model results for the 1% AEP event;
- Indicative flood flow routes assessed based on topography; and,
- CDA boundaries, as defined in the CDA Delineation Methodology[21].

CDA:	Clapham
London Borough:	London Borough of Lambeth
Surface Water Hazard Zone	Triangle of land between Bedford Road, St Luke's Avenue and the A3.
Flooding Mechanism Description	Surface water predominantly flows from the south-western towards the north-east and Clapham North station. Sewers are at capacity throughout the CDA for all storm events from the 3.3% AEP upwards. These sewers are predicted to surcharge in the lower reaches of the catchment. The main surface water flow path forms by the Lambeth Academy and flows north-east towards Clapham North, ponding around Cato Road and leading to flood depths in excess of 0.85m for the 1% AEP. event Surface water runoff is not well contained within carriageways and property flooding is predicted along Kenwyn Road and Cato Road. In the lower reaches of the catchment near Clapham North the sewers are surcharged for a prolonged period of time persistent surface water flooding. Even though this updated SWMP does not look specifically at the variation in flood risk associated with ponding durations, this should be accounted for when identifying potential mitigation options and communicating with stakeholders. Refer to Figure 12 Clapham CDA Flood Depths for the 1% AEP.
Property Count	823 residential properties and 80 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Connectivity	Clapham CDA drains to South Lambeth CDA.

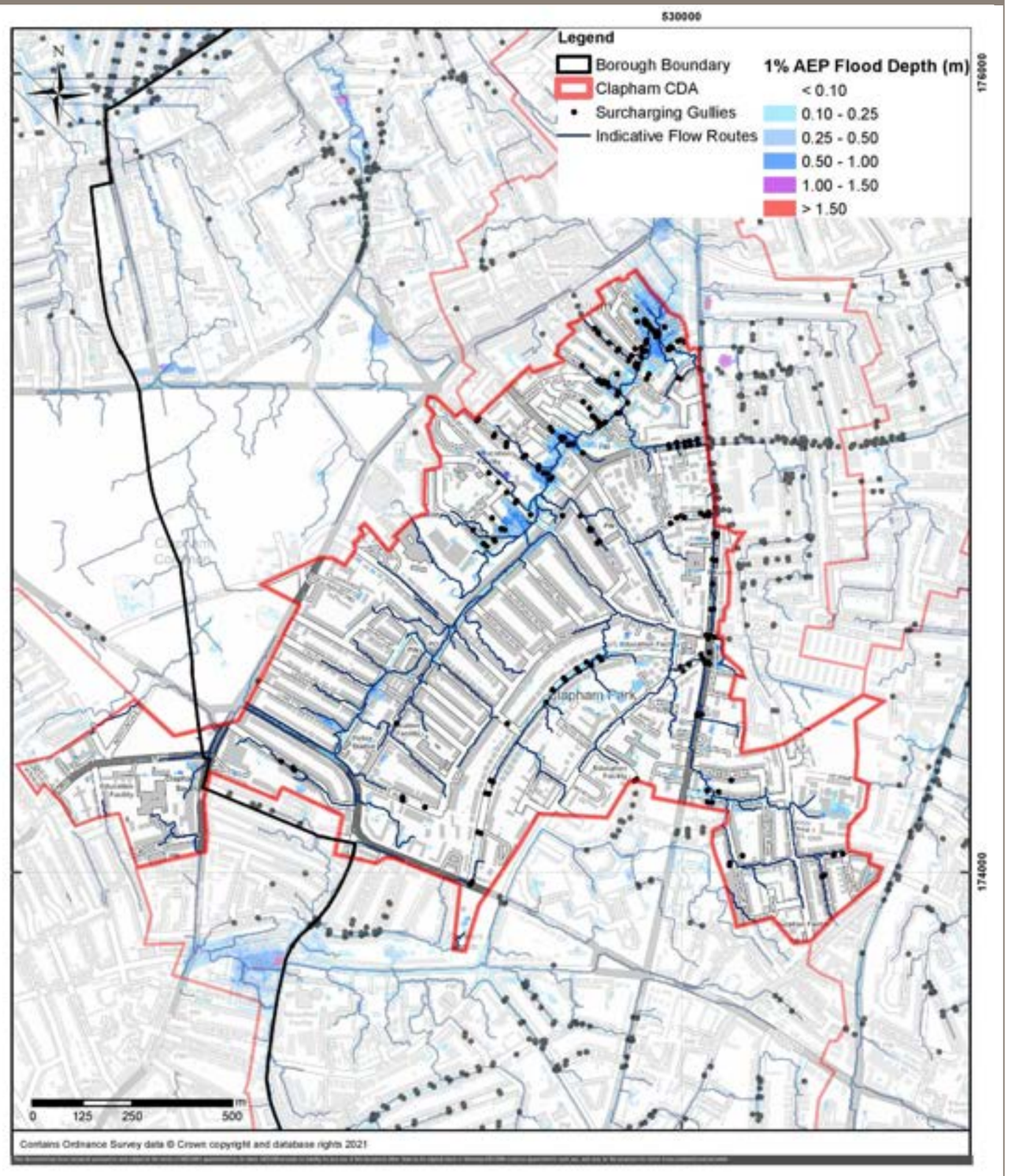


Figure 12 Clapham CDA Flood Depths for the 1% AEP

CDA:	Oval
London Borough:	London Borough of Lambeth
Surface Water Hazard Zone	Brixton Hill, land between Brixton Hill, Caldwell Street, Handforth Road and the A3
Flooding Mechanism Description	The Oval CDA is characterised by surface water runoff flowing from the south of the catchment towards the north and the River Thames. The CDA is heavily urbanised with limited areas of natural open space, and the topography naturally flattens out in the north and the west, along the banks of the River Thames. The CDA is drained by several large trunk sewers, with the largest of these assets under Brixton Road and the A3. These trunk sewers ultimately drain to the Crossness Sewerage Treatment Works. During severe storm events flows are discharged to the Thames as combined sewer overflows (CSOs). These trunk sewers (one storm sewer and one combined sewer) also drain large extents of south London and are flowing at capacity in the 3.3% AEP event and are predicted to surcharge in the 1% AEP event. The combined sewer is also predicted to surcharge during the 3.3% AEP event. The sewer networks serving Oval back up and surcharge early on during the 1% AEP event. Brixton Road forms a preferential pathway for surface water runoff coming from a combination of surcharged sewers and pluvial water unable to enter the sewer network. Flow rates along Brixton Road exceed 6.5m^3/s for the 1% AEP event. This flow path continues towards the west and Vauxhall at the intersection between Brixton Road and South Island Place. Properties along these roadways are predicted to be impacted by flooding. Note: the TW Detailed Sewer Network and the gully data provided by LBL do not include any gullies along Brixton Road. As gullies are visible within the carriageway, this is a model limitation which should be addressed in the future. Refer to Figure 13 Oval CDA Flood Depths for the 1% AEP.
Property Count	2,977 residential properties and 406 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Connectivity	West Norwood, West Dulwich, Tulse Hill and Railton Road CDAs all drain to the Oval CDA.

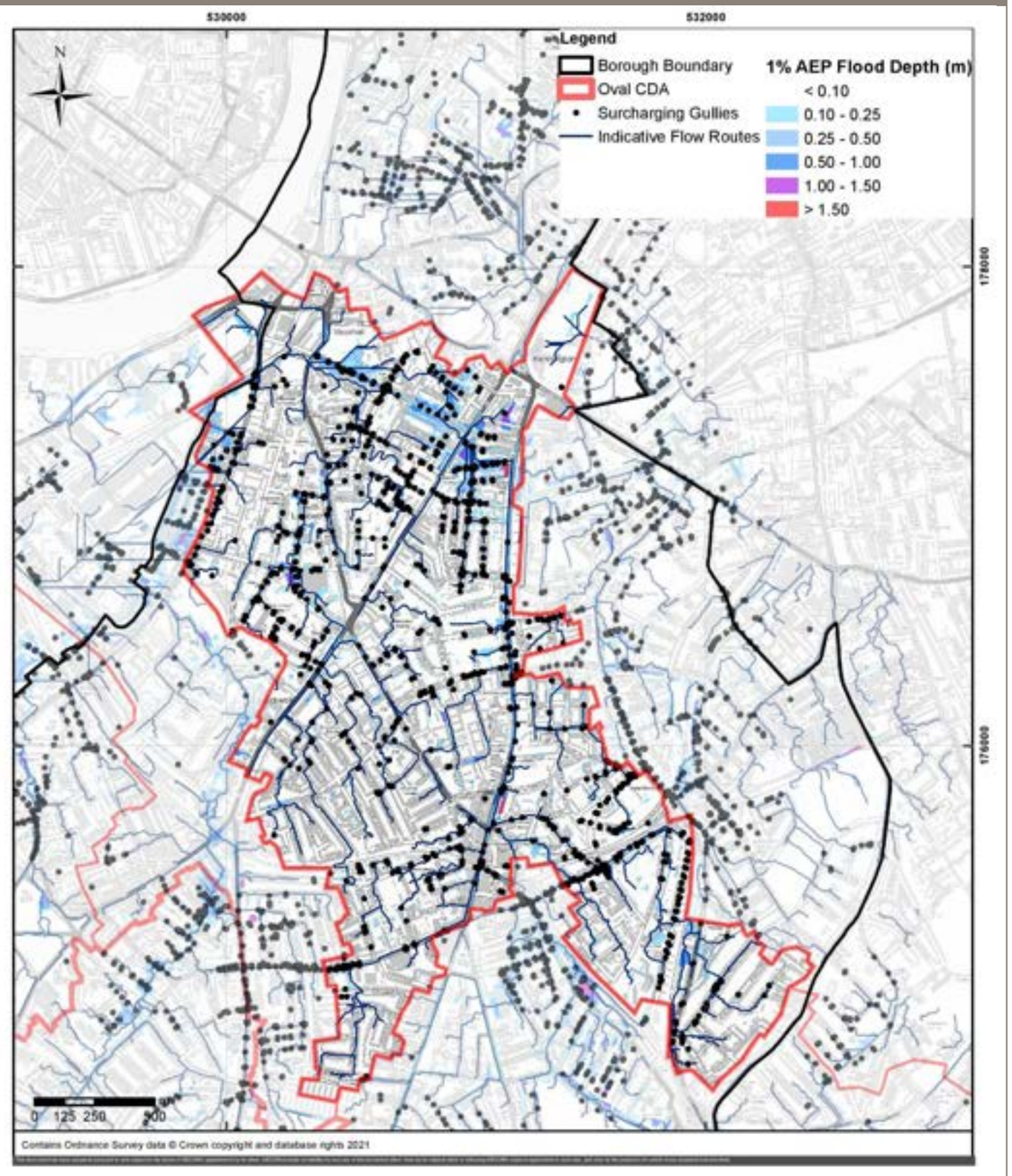


Figure 13 Oval CDA Flood Depths for the 1% AEP

CDA:	Railton Road
London Borough:	London Borough of Lambeth, London Borough of Southwark
Surface Water Hazard Zone	Herne Hill, Dulwich Road, Half Moon Lane, Croxted Road, Railton Road
Flooding Mechanism Description	The Railton Road CDA at Herne Hill is a natural convergence point for the West Dulwich, Tulse Hill, and the eastern portion of the Railton Road CDAs. This is due to the topography creating valleys that drain to the Norwood Road and Dulwich Road junction at Herne Hill. Flood water is predicted to accumulate in the natural depression around Herne Hill before continuing, along Dulwich Road and on to Railton Road where a significant number of properties are at risk of flooding. Another major flow path within the Railton Road CDA drains adjacent to Tulse Hill Road (A204), west of Brockwell Park. This flow path meets the above flood flow route at the junction of Tulse Hill, Brixton Water Lane, diverts eastwards to Dulwich Road, and then on to Railton Road. The convergence point of multiple flood flow routes within the Railton Road leads to large extents of flooding during all AEPs. Flood depths are predicted to exceed 1.21m in the 1% AEP event. The sewer under Dulwich Road is not flowing at capacity during the 1% AEP event. There are numerous suitably located gullies along Dulwich Road which suggests surface water runoff is not being efficiently captured and discharged by the existing gully system. At the downstream end of the catchment, surface water runoff accumulates in a natural low point between Railton Road and Mayall Road. Flooding of numerous residential properties is predicted during the 1% AEP event with depths of water up to 1.6m. Refer to Figure 14 Railton Road CDA Flood Depths for the 1% AEP.
Property Count	1,681 residential properties and 238 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Connectivity	West Dulwich and Tulse Hill CDA both drain via the Railton Road CDA. The points of connection are by Turney Road and Herne Hill respectively. Railton Road CDA drains to the Oval CDA. The point of connection is by Brixton Station.

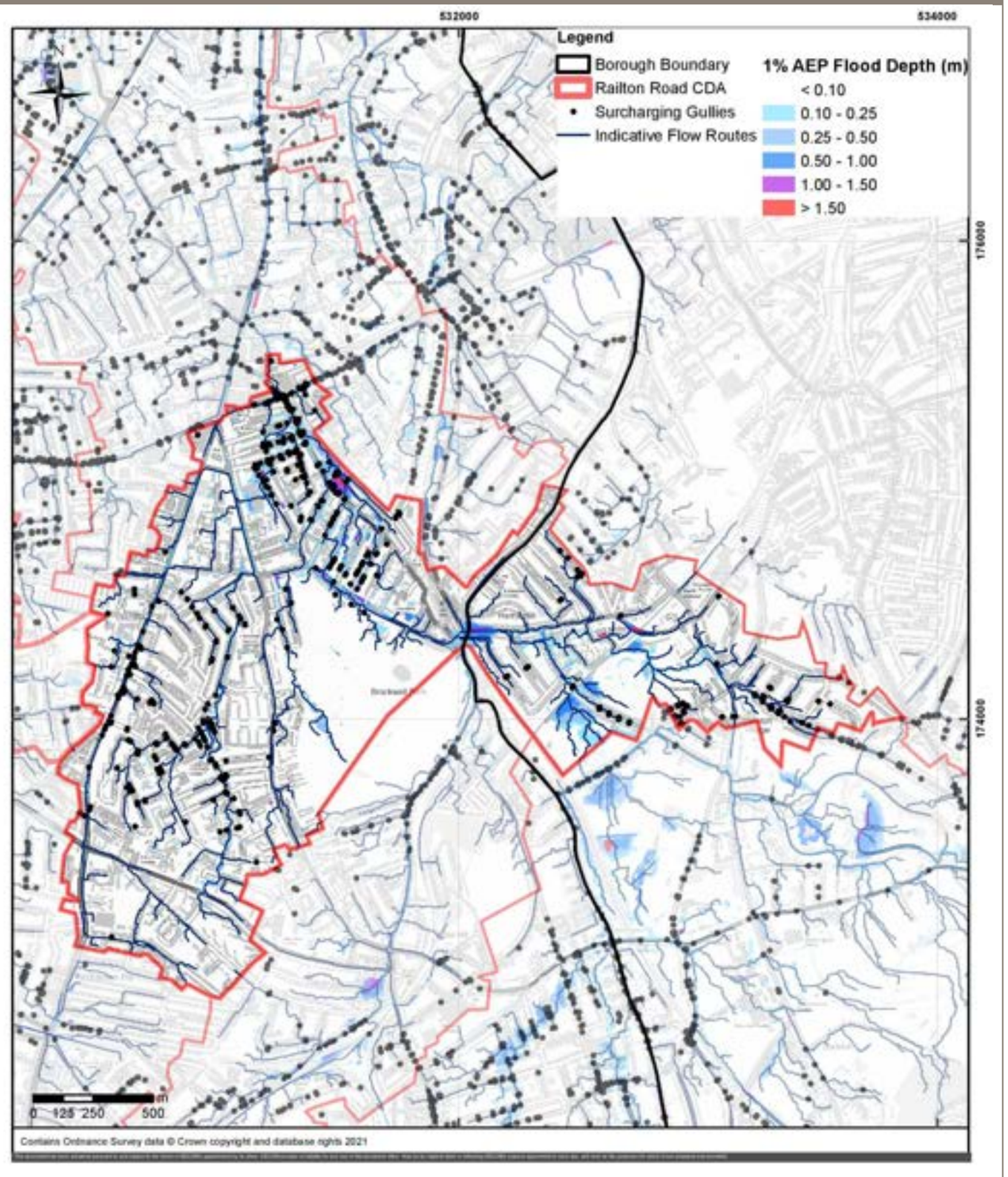


Figure 14 Railton Road CDA Flood Depths for the 1% AEP

CDA:	South Lambeth
London Borough:	London Borough of Lambeth, London Borough of Wandsworth
Surface Water Hazard Zone	Courland Grove, Union Grove and Blore Close/ Carey Gardens area.
Flooding Mechanism Description	The South Lambeth CDA is located downstream of the Clapham CDA and their flooding mechanisms are intrinsically linked. Surface water runoff flows from the Clapham CDA (from Clapham North station) and from Bedford Road north towards Larkhall Park and LBW. Runoff from the Clapham CDA, Clapham Common and Bedford Road accumulates along the A3 and in the underpass below the rail bridge by Clapham North. Despite water ponding to depths of up to 0.80m, the sewers under the A3 have capacity in the 1% AEP event. This suggests the gully network should be improved to capture more surface water flow. The sewer under Bedford Road is at capacity in the 3.3% AEP event and surcharges in the 1% AEP event. Surface water runoff continues to flow north towards Larkhall Park. Flood flows through the Clapham Road Estate and the back gardens of residential properties before flowing along Larkhall Park. Surface water runoff is conveyed along the carriageway through Gaskell Street, Courland Grove and Union Grove. Local sewers have limited capacity in the 1% AEP event. At the downstream end of the catchment, runoff from the upper parts of the CDA as well as runoff from Larkhall Park itself accumulates in the low point around the Blore Close and Carey Gardens Estates. Sewers in Wandsworth Road and north of Wandsworth Road are all at capacity in the 3.3% AEP event. Widespread surcharging in the 1% AEP is predicted. Peak flood depth in this part of the catchment is not attained until several hours after the peak of the storm, and the area drains significantly more slowly than further upstream. Refer to Figure 15 South Lambeth CDA Flood Depths for the 1% AEP.
Property Count	947 residential properties and 133 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Connectivity	Clapham CDA drains via South Lambeth CDA. The point of connection is by Cato Road.

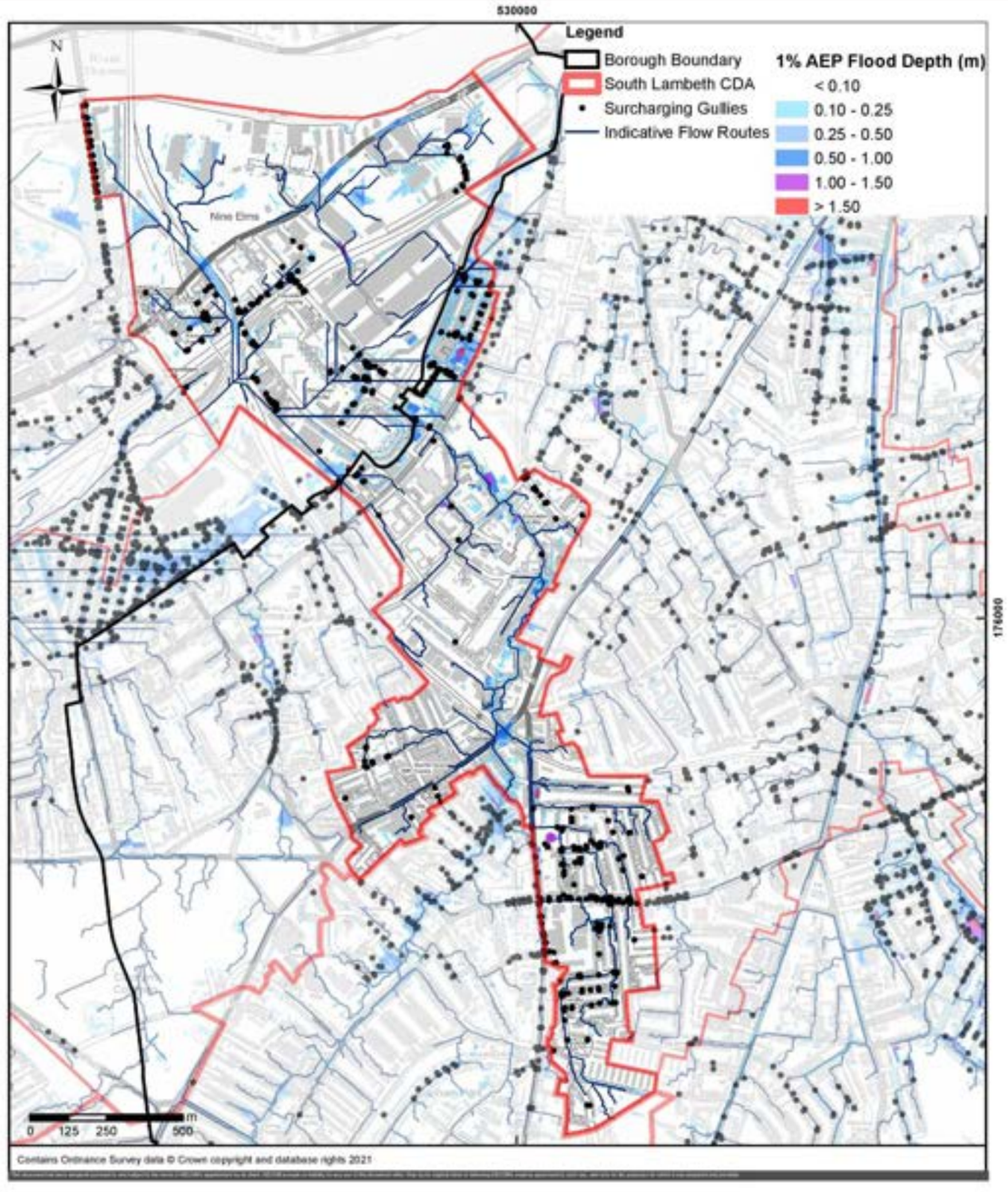


Figure 15 South Lambeth CDA Flood Depths for the 1% AEP

CDA:	Streatham
London Borough:	London Borough of Lambeth
Surface Water Hazard Zone	Network Rail land behind Streatham station, Streatham High Road
Flooding Mechanism Description	The Streatham CDA has surface water runoff flowing from east to west which follows the natural topography. These flows accumulate within the Network Rail land upstream of Streatham Station. Flood water impounds against Streatham High Road embankment with depths of flooding predicted to exceed 1.0m in the 1% AEP event. There are three distinct surface water flow pathways in the CDA. Closest to Streatham Station, from the north, sewers within Wellfield Road surcharge in the 3.3% AEP and excess water flows down towards the low point in the catchment, cutting through properties and down Ashkale Road and Stanhorpe Road. To the north-east, the sewer located under Valley Road is at capacity in the 3.3% AEP event, and surcharges in the 1% AEP event. Both the sewer surcharge, and runoff from the open land and sports fields east of the road accumulate within the carriageway before flowing downhill following the topography, through Sunnyhill School and through Madeira Road towards Streatham Station. Finally, sewers upstream of Valleyfield Road are also at capacity in the 3.3% AEP event. Due to the steepness of this area, sewers surcharge at the bottom of the hill, between Valleyfield Road and Glendale Road. Surface water runoff is conveyed along the carriageway and merges with the flow path coming from Valley Road around the Madeira Road area. Refer to Figure 16 Streatham CDA Flood Depths for the 1% AEP.
Property Count	473 residential properties and 85 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Connectivity	None.

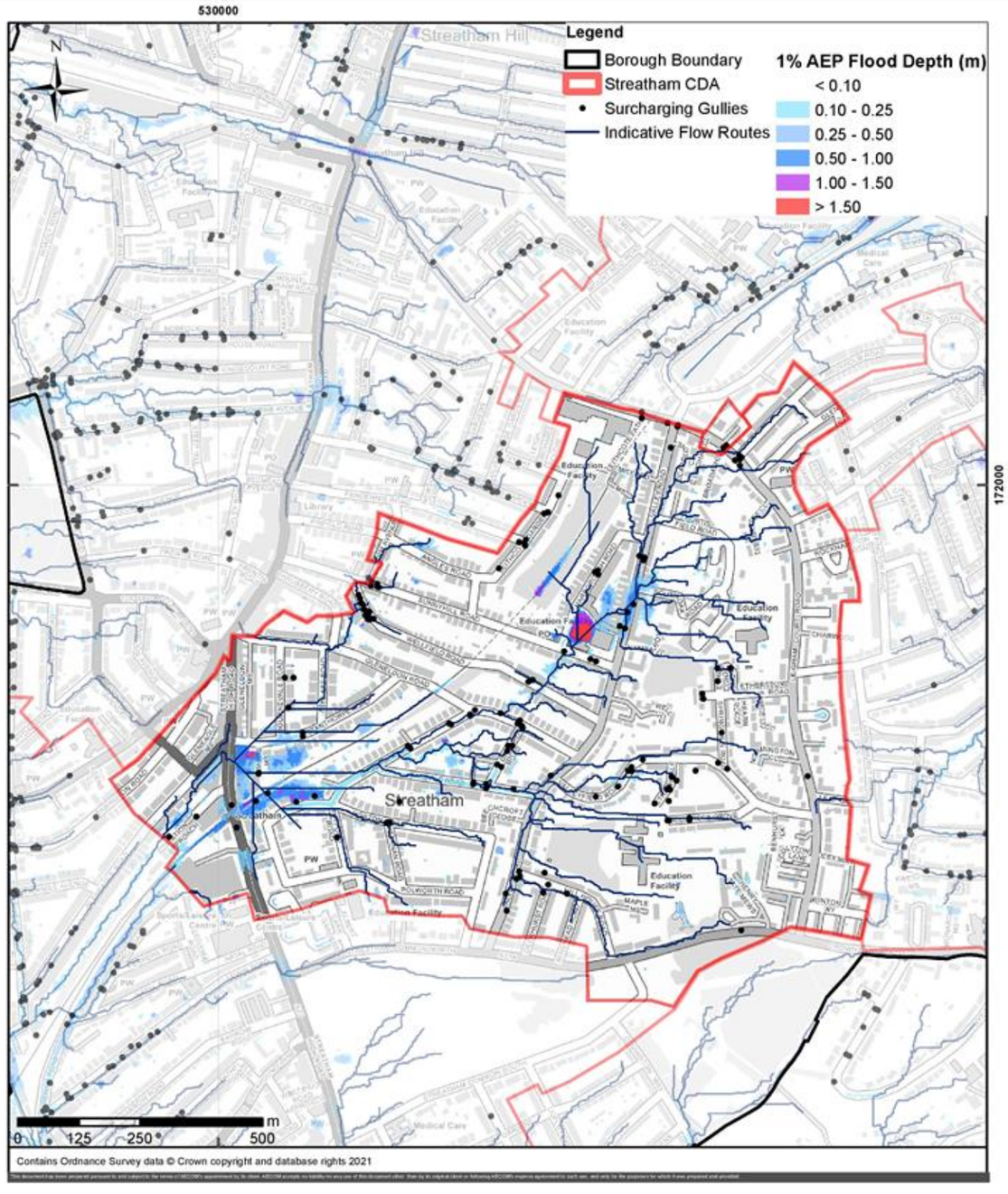


Figure 16 Streatham CDA Flood Depths for the 1% AEP

CDA:	Streatham Hills
London Borough:	London Borough of Lambeth, London Borough of Wandsworth
Surface Water Hazard Zone	Land between Cavendish Road and Lammermoor Road (LBW), Cavendish Road
Flooding Mechanism Description	The Streatham Hills CDA has surface water runoff flowing from the east and south of the catchment towards the north-west and onwards through the London Borough of Wandsworth. Sewers are at capacity and surcharging in the upper parts of the catchment around Tierney Road and Gracefield Gardens for the 3.3% AEP event upwards. Overland flow unable to enter the network and sewer surcharge are conveyed along roadways following topography towards the low point at the intersection between Cavendish Road and Atkins Road. Surface water from the southern part of the catchment is conveyed through Tooting Bec Common, alongside the railway, before entering Cavendish Road. Surface water from the north-eastern part of the catchment is conveyed along Atkins Road and Hydethorpe Road towards Cavendish Road. Note: the TW Detailed Sewer Network and the gully data provided by LBL do not include any gullies along Cavendish Road. As gullies are visible within the carriageway, this is a model limitation which should be addressed in the future. Refer to Figure 17 Streatham Hills CDA Flood Depths for the 1% AEP.
Property Count	909 residential properties and 167 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Connectivity	None.

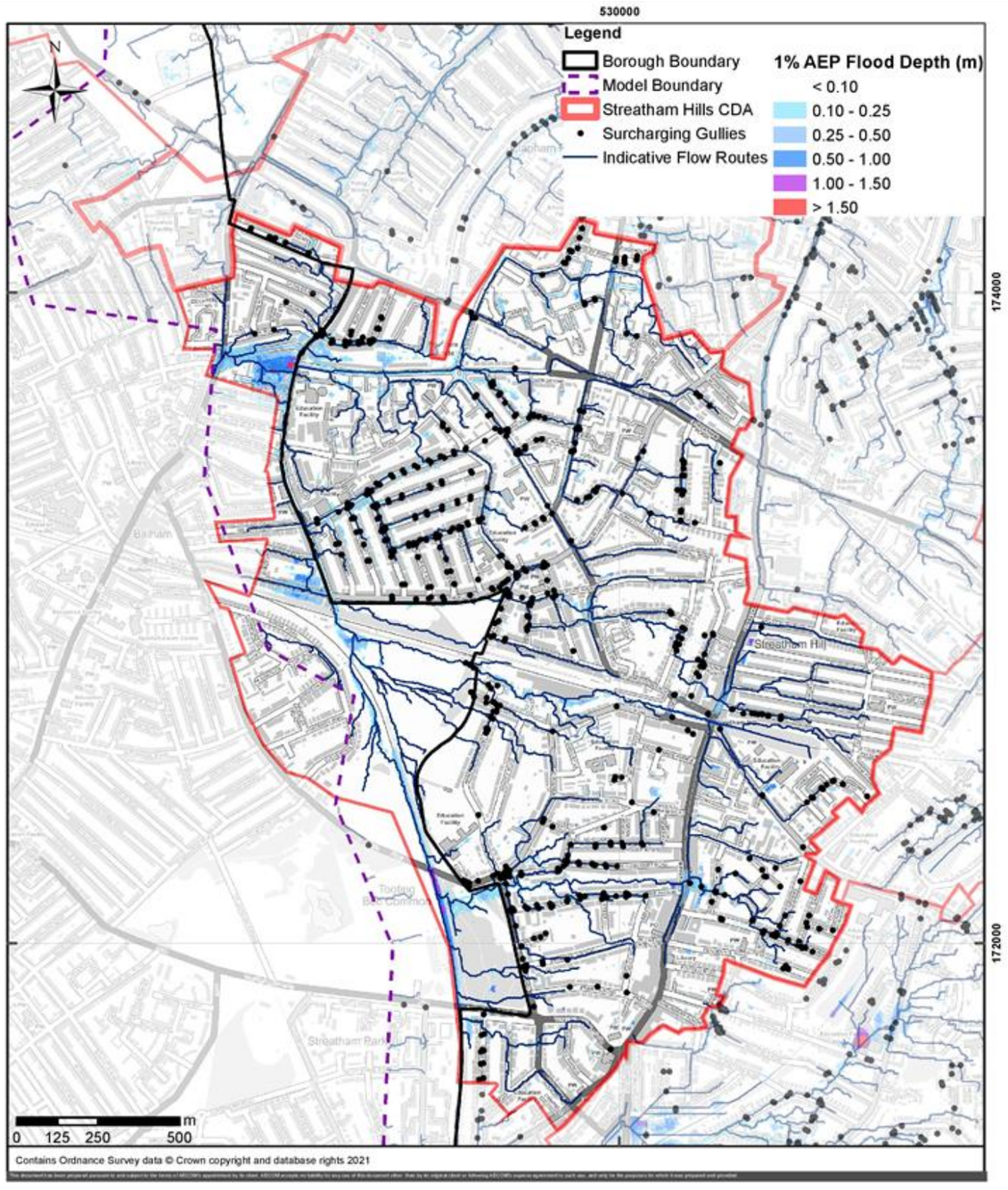


Figure 17 Streatham Hills CDA Flood Depths for the 1% AEP

CDA:	Streatham Vale
London Borough:	London Borough of Lambeth, London Borough of Croydon
Surface Water Hazard Zone	Area between Streatham Vale, Abercairn Road, Farmhouse Road, and Braeside Road
Flooding Mechanism Description	The Streatham Vale CDA is located on the border between LBL and LBC. Surface water runoff flows from north-east to south-west, emanating from Rookery, Gardens and following the natural valley from the River Graveney before accumulating against the Network Rail sidings west of Abercairn Road. Sewers across the CDA are surcharging along their entire length in the 3.3% AEP event. As local topography is steep, runoff from the Rookery Gardens flows straight into Briar Gardens and Cedarville Avenue. It then joins the Graveney River catchment from Norbury. Approximately 20% of flow entering Streatham High Road in Norbury (2.75m^3/s) originates from the Rookery Gardens (0.63m^3/s). In Norbury, water accumulates along Streatham High Road and car parks by Norbury Park, spanning the border between LBL and LBC. Surface water runoff ultimately follows the course of the Graveney River by flowing within the carriageway of parallel roads down to Streatham Vale. Refer to Figure 18 Streatham Vale CDA Flood Depths for the 1% AEP.
Property Count	319 residential properties and 23 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Connectivity	None.

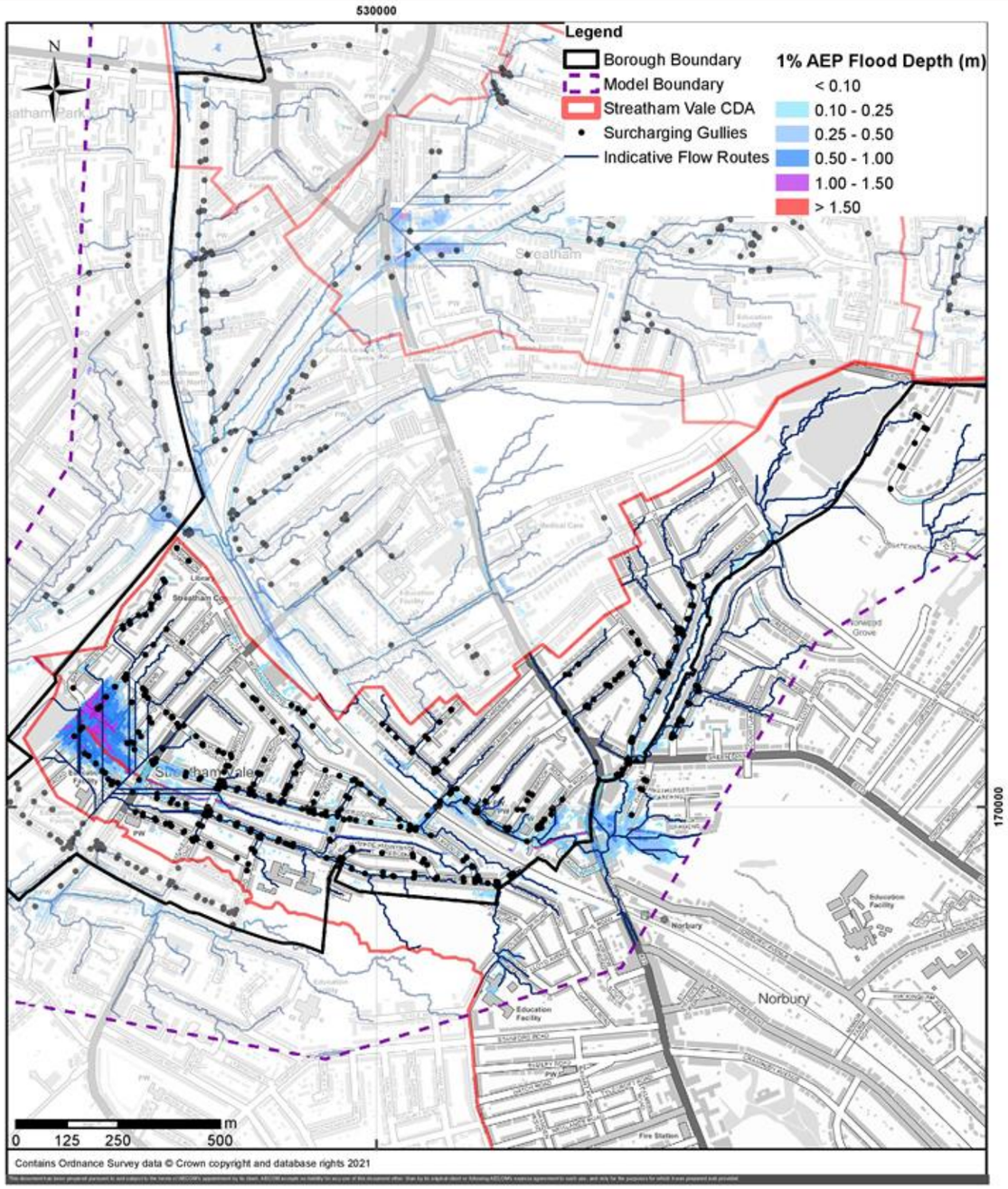


Figure 18 Streatham Vale CDA Flood Depths for the 1% AEP

CDA:	Tulse Hill
London Borough:	London Borough of Lambeth
Surface Water Hazard Zone	Along Norwood Road and to the junction between Dulwich Road, Norwood Road and Half Moon Lane.
Flooding Mechanism Description	Surface water runoff is from the southern part of the catchment towards the north-east and Herne Hill station. The catchment is constrained by a natural valley from the south-west of the catchment towards Tulse Hill Station and then along Norwood Road towards Herne Hill Station. The catchment is heavily urbanised with limited areas of natural open space. A 375mm diameter sewer network in the upper parts of the catchment (towards Leigham Court Road and Leigham Vale) surcharges for all storm events from the 3.3% AEP upwards. The sewer size increases to a large 762 x 1143mm elliptical sewer under Norwood Road, which although at capacity does not surcharge until the 0.1% AEP event. Norwood Road drains the entire CDA via the sewer network and the natural topography. Flow rates exceeding 5m^3/s parallel to Brockwell Park. Water depths in Norwood Road do not exceed 0.35m and the main cause of flood risk is fast flowing water. Refer to Figure 19 Tulse Hill CDA Flood Depths for the 1% AEP.
Property Count	510 residential properties and 76 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Links	Tulse Hill CDA drains to Railton Road and Oval CDAs.

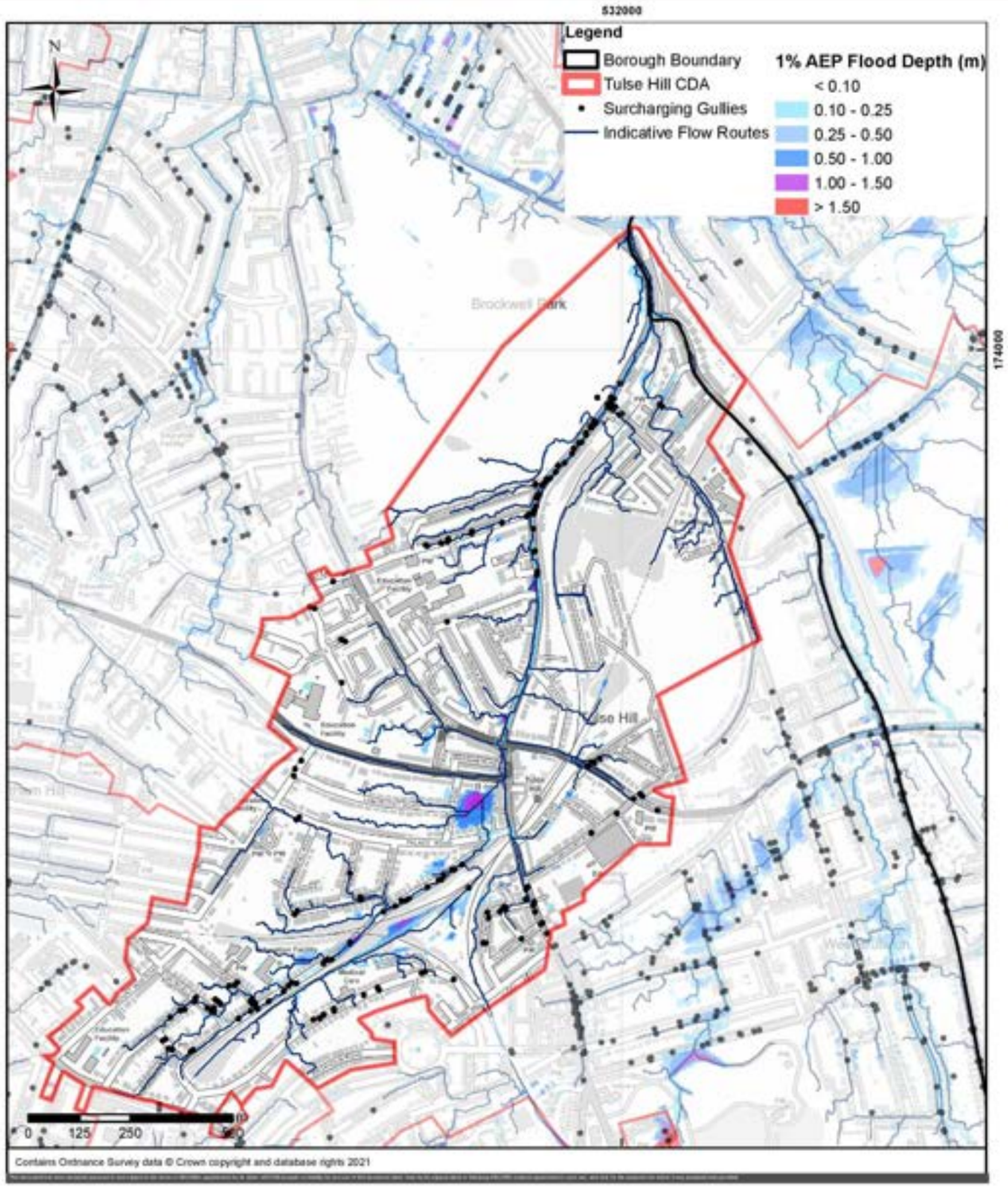


Figure 19 Tulse Hill CDA Flood Depths for the 1% AEP

CDA:	Wandsworth Road
London Borough:	London Borough of Lambeth, London Borough of Wandsworth
Surface Water Hazard Zone	Robertson Street area.
Flooding Mechanism Description	The Wandsworth Road CDA is located on the border between LBL and LBW. Surface water runoff flows from Clapham Common at the south of the catchment, towards the north and Robertson Street. Land falls steeply to the north, away from Clapham Common, and surface water is conveyed along these carriageways towards the LBW. Runoff is also conveyed from the eastern part of Clapham Common through Rectory Grove. The smaller diameter sewers in this part of the catchment surcharge in the 3.3% AEP event, adding to the runoff from Clapham Common. The flow path, following the topography, cuts through residential properties alongside Fitzwilliam Road flowing towards the LBW. The catchment topography flattens north of Wandsworth Road and all sewers in this area surcharge in the 3.3% AEP event. Combined with the two surface water runoff flow paths described above; a large volume of water accumulates around Robertson Street to depths of up to 0.75m in the 1% AEP event. Sewers are predicted to remain surcharging beyond the peak of the storm, leading to surface water ponding for long durations. Even though this updated SWMP does not look specifically at the variation in flood risk associated with ponding durations, this should be accounted for when identifying potential mitigation options and communicating with stakeholders. Note: the TW Detailed Sewer Network and the gully data provided by LBL do not include any gullies along Long Road. As gullies are visible within the carriageway, this is a model limitation which should be addressed in the future. Refer to Figure 20 Wandsworth Road CDA Flood Depths for the 1% AEP.
Property Count	883 residential properties and 109 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Links	None.

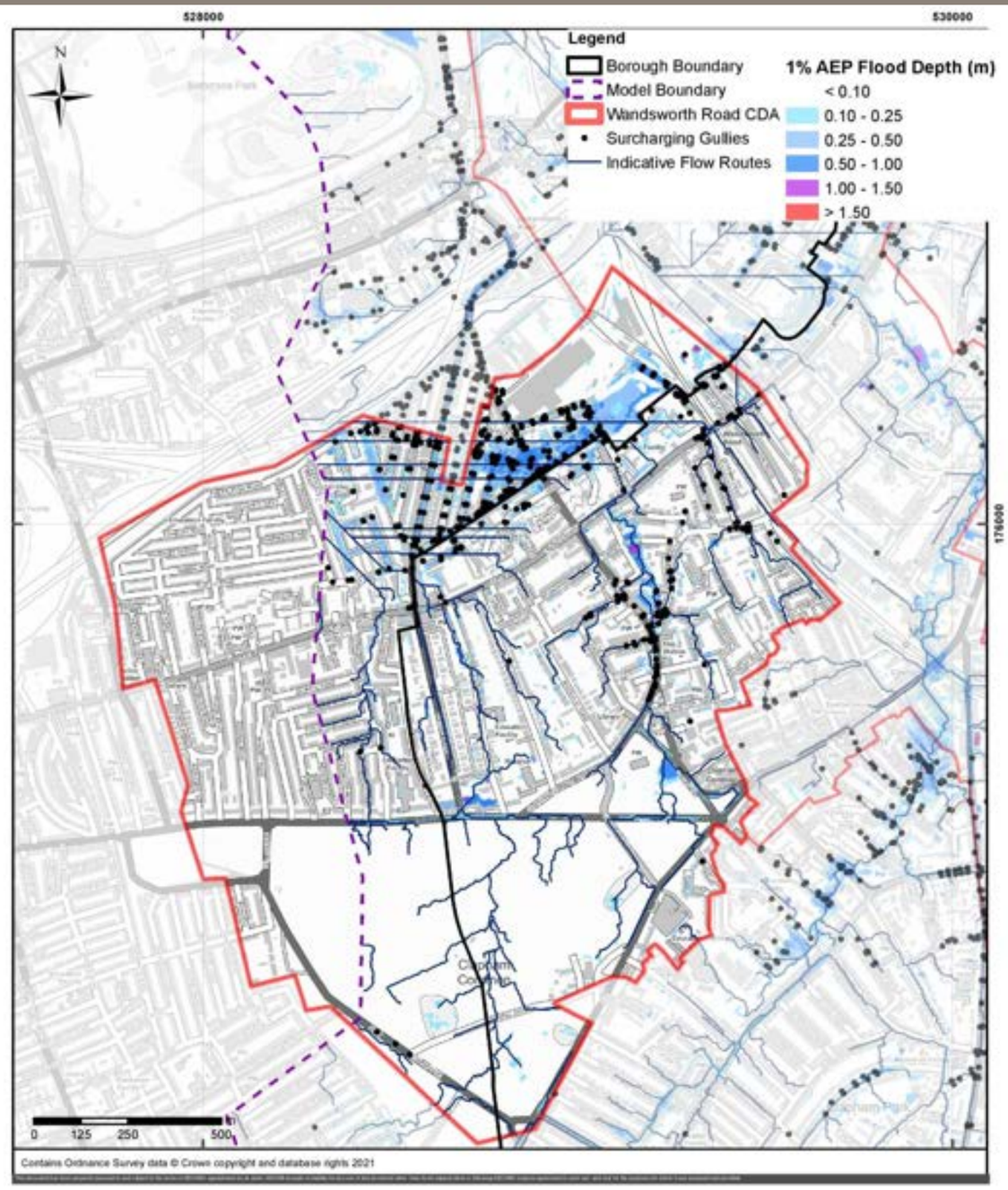


Figure 20 Wandsworth Road CDA Flood Depths for the 1% AEP

CDA:	West Dulwich
London Borough:	London Borough of Lambeth, London Borough of Southwark
Surface Water Hazard Zone	Croxted Road
Flooding Mechanism Description	The West Dulwich CDA is located on the border between LBL and LBS. Surface water runoff flows from south to north, towards Herne Hill, following local topography. Within LBL, there are two major surface water runoff paths. The first originates in Upper Norwood (via the West Norwood CDA) and takes the historic path of the River Effra, that was culverted in the later 1800s to form the combined sewer network. Within the West Dulwich CDA, flood flows appear from the sewer network surcharging at Robson Road during the 1% AEP event. This flow continues along the historic path of the River Effra through residential properties and back gardens. The properties along the flow path are predicted to be inundated to depths of up to 0.80m in the 1% AEP event. The Robson Road sewer does not surcharge in the 3.3% AEP event and flow paths are predicted to be limited during this event. The above flow path converges with the second major runoff near the junction of Thurlow Park Road and Croxted Road. This second flow path originates in the Gipsy Hill area around Central Hill and Westow Hill. At Berridge Close the sewer network is predicted to surcharge during the 3.3% AEP event. Surface water flows through back gardens following the natural valley before reaching South Croxted Road where it is conveyed within the carriageway towards West Dulwich and Herne Hill. The Gipsy Hill/A2199/South Croxted Road junction (Paxton Green roundabout) is the confluence of three major flow paths originating in Lambeth and Southwark, and all contribute to flood risk through West Dulwich and then on to the Herne Hill area. Approximately 2.10m^3/s of surface water flows north from this junction compared to the 5.10m^3/s discharging into Herne Hill from Burbage Road during the 1% AEP. Refer to Figure 21 West Dulwich CDA Flood Depths for the 1% AEP.
Property Count	1,127 residential properties and 82 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Links	West Norwood CDA drains via West Dulwich CDA. The point of connection is near West Norwood Cemetery. West Dulwich CDA drains to Railton Road CDA. The point of connection is near Turney Road.

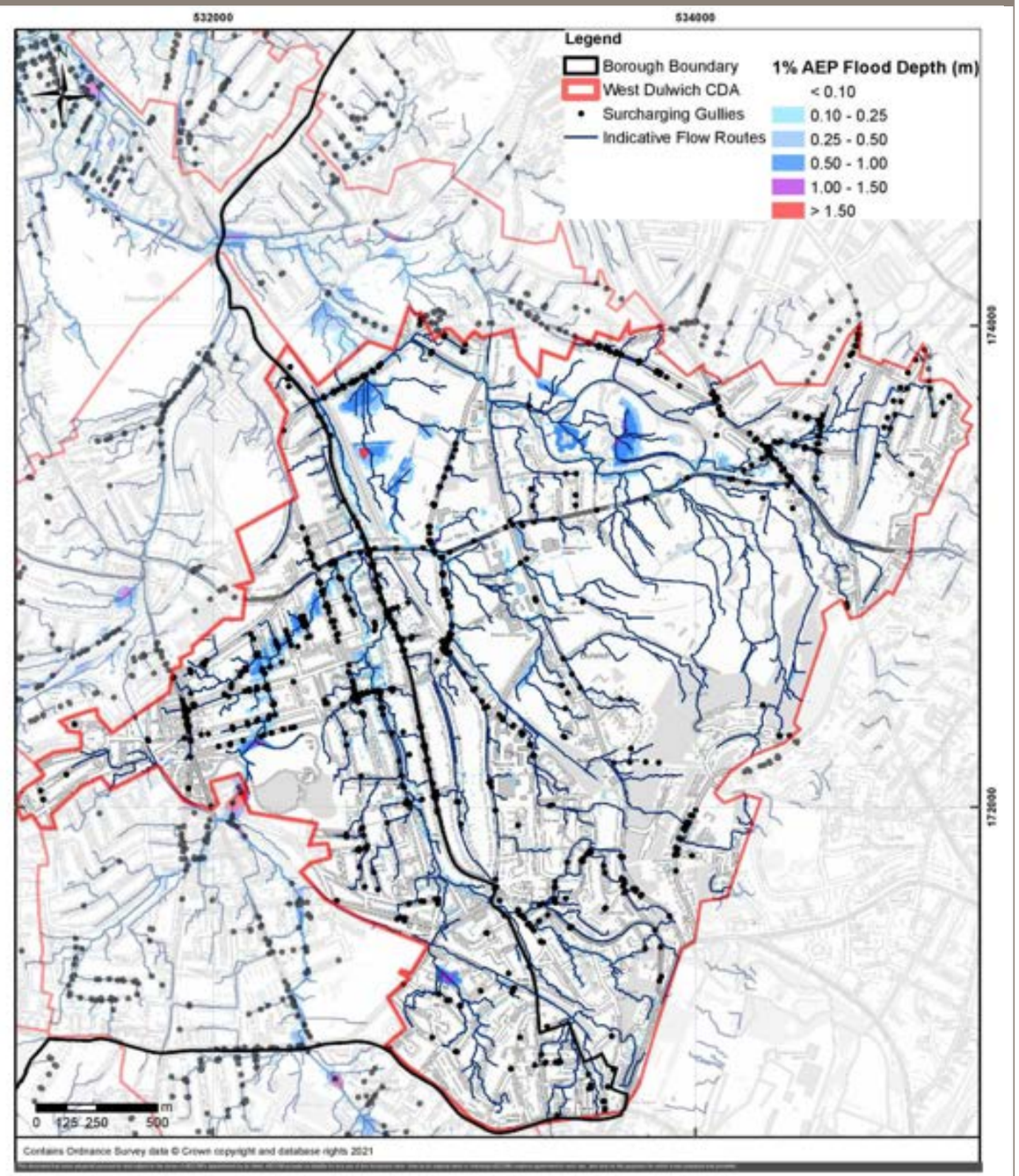


Figure 21 West Dulwich CDA Flood Depths for the 1% AEP

CDA:	West Norwood
London Borough:	London Borough of Lambeth, London Borough of Croydon
Surface Water Hazard Zone	Gibbs Avenue, Network Rail line between Gipsy Road and West Norwood, West Norwood station area
Flooding Mechanism Description	The West Norwood CDA is located on the border between LBL and LBC. Surface water runoff flows from south to north, towards West Norwood and eventually Herne Hill, following the course of the River Effra. Within LBL, there are two major surface water runoff paths. The main flow path follows the course of the now culverted "lost" River Effra from the Westow Park area. Sewers are predicted to surcharge in this most upstream part of the catchment during the 3.3% AEP event. Surcharged runoff and pluvial runoff unable to enter the sewer network flow towards West Norwood, ponding around properties located on Gibbs Avenue. Back gardens behind Norwood Park, off Norwood Park Road are predicted to be inundated. A second flow path converges near West Norwood Station, emanating from surcharging sewers in the 3.3% AEP event on Lakeview Road. The steepness of the catchment leads to a rapid increase in flow being conveyed through property back gardens between Cheviot Road and Casewick Road. Both flows contribute equally to the risk of flooding by West Norwood station, with roughly 4m^3/s coming from each flow path during the 1% AEP event. Refer to Figure 22 West Norwood CDA Flood Depths for the 1% AEP.
Property Count	408 residential properties and 84 commercial and industrial properties flood to a depth > 0.2m.
Hydraulic Links	West Norwood CDA drains to West Dulwich CDA. The point of connection is near West Norwood Cemetery.

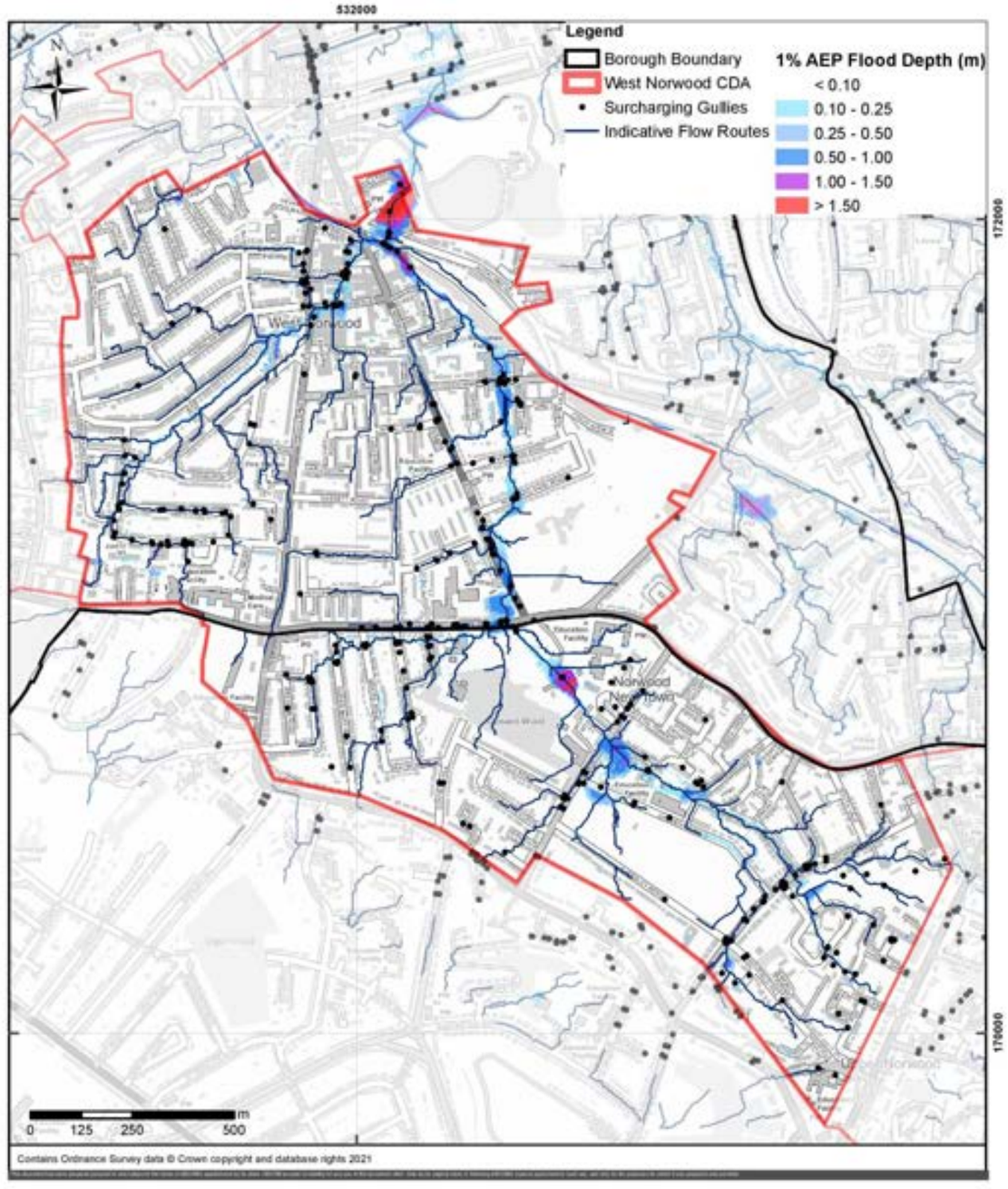


Figure 22 West Norwood CDA Flood Depths for the 1% AEP

4. Phase 3: Options

4.1 Objectives

This chapter focuses on measures which can be taken to mitigate surface water flood risk. Once identified the measures were shortlisted to determine whether they should be taken forward to the appraisal process.

To maintain continuity with Phase 2 of this report, as well as facilitate the review and incorporation of this updated SWMP into the planning process, this assessment was undertaken for each CDA.

Phase 3 of the updated SWMP provides a high-level assessment of possible surface water flood risk mitigation options available to each CDA. These options have been defined based on the outputs from Phase 2 of the updated SWMP, as well as engineering judgement. No hydraulic modelling or design work was undertaken to assess the effectiveness of each option.

4.2 Measure Identification

The identification process recognises all possible measures that could be taken to manage surface water flood risk. The range of options is not constrained by funding or delivery concerns and encompasses all options available. This ensures interactions with other sources of flooding are acknowledged and all the potential benefits are recognised.

A range of structural, non-structural and adaption measures are proposed which provide different levels of protection from surface water flooding and have a range of benefits and costs associated with them. Preference is given to measures achieving multiple benefits, such as water quality biodiversity and added amenity value. It was important to consider other local investment plans in the Borough simultaneously, such as local green infrastructure and highway schemes. Major commercial or housing re-development also offer opportunity to retrofit surface water management measures.

In the options assessment, structural measures are considered those which require fixed or permanent assets to mitigate flood risk. Non-structural measures are responses to urban flood risk that reduce risk through a process of changing behaviours.

The mitigation measures can be further categorised into three main counterparts: source, pathway and receptor. The types of the SuDS under each category is listed in Table 8 below and can be visualised in Figure 23.

A measures assessment was undertaken for each CDA to evaluate possible opportunities to implement the structural and non-structural measures identified in Table 8. The results are summarised in Table 9.

Table 8 Structural and Non-Structural Measures for Consideration

Source	Pathway	Receptor
Green Roof Soakaways Swales Permeable Paving Rainwater Harvesting Detention Basins Ponds and Wetlands Natural Flood Management	Increasing Capacity in Drainage System 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 Watercourses	Improved Weather Warning Planning Policies to Influence Development Temporary or Demountable Flood Defences Social Change, Education or Awareness Improved Resilience and Resistance Measures

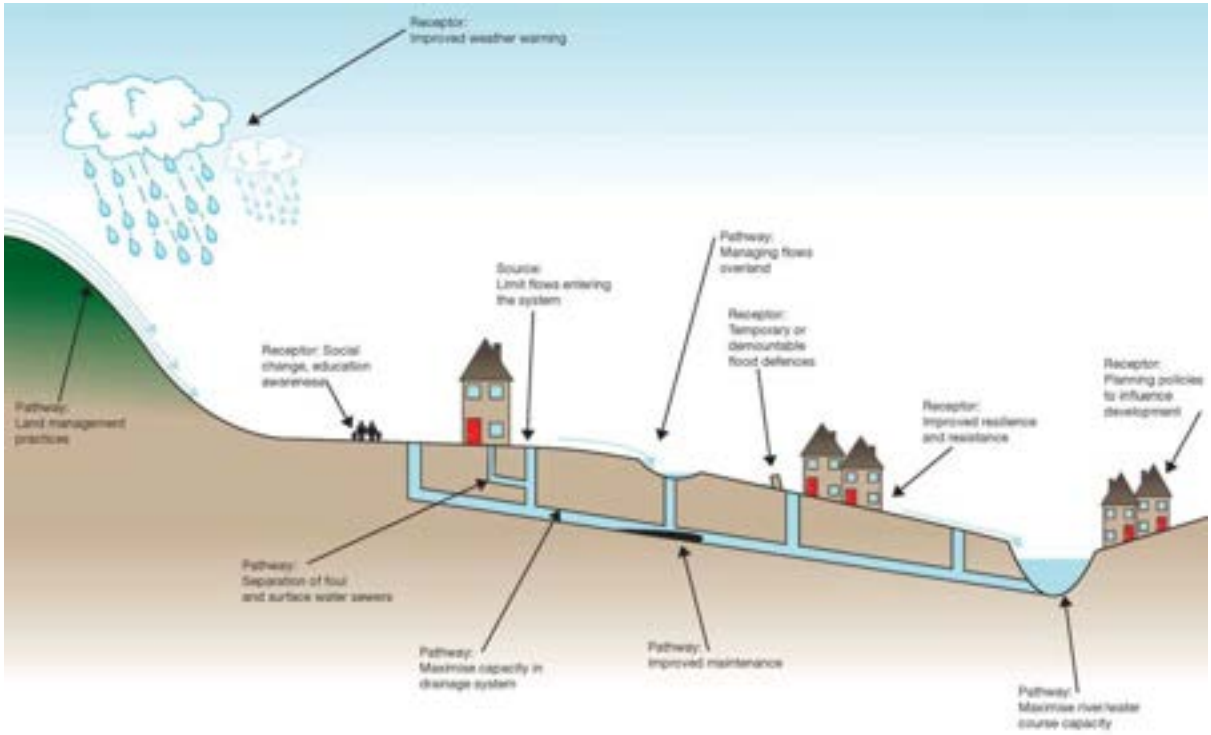


Figure 23 Source-Pathway-Receptor Model (Source: SWMP Technical Guidance, 2010[1])

Table 9 Measures Opportunity Assessment

Source/Pathway/ Receptor	Measure	Clapham	Tulse Hill	Oval	Railton Road	South Lambeth	Streatham	Streatham Hills	Streatham Vale	Wandsworth Road	West Dulwich	West Norwood
Source	Green Roof	y	o	y	o	y	o	o	o	o	o	y
Source	Soakaways	o	o	o	o	o	o	o	o	o	o	o
Source	Swales	o	y	o	y	o	o	y	y	o	o	o
Source	Permeable Paving	y	y	y	y	y	y	y	y	y	y	y
Source	Rainwater Harvesting	y	y	y	y	y	y	y	y	y	y	y
Source	Detention Basins	y	o	o	o	o	o	o	y	y	y	y
Source	Ponds and Wetlands	n	n	n	y	n	n	n	y	y	y	o
Source	Natural Flood Management	n	n	n	y	n	n	n	y	n	n	n
Pathway	Increasing Capacity in Drainage System	y	y	y	y	y	y	y	y	y	y	y
Pathway	Separation of Foul and Surface Water Sewers	y	y	y	y	y	y	y	y	y	y	y
Pathway	Improved Maintenance Regimes	y	y	y	y	y	y	y	y	y	y	y
Pathway	Managing Overland Flows (online storage)	n	y	n	o	o	o	o	y	o	y	y
Pathway	Managing Overland Flows (preferential flow paths)	y	y	y	y	y	y	y	y	y	y	y
Pathway	Land Management Practices	n	n	n	n	n	n	n	n	n	n	n
Pathway	Deculverting Watercourses	n	n	n	n	n	n	n	o	n	n	n
Receptor	Improved Weather Warning	o	o	o	o	o	o	o	o	o	o	o
Receptor	Planning Policies to Influence Development	y	y	y	y	y	y	y	y	y	y	y
Receptor	Temporary or Demountable Flood Defences	y	o	o	y	y	y	y	y	y	y	y
Receptor	Social Change, Education or Awareness	y	y	y	y	y	y	y	y	y	y	y
Receptor	Improved Resilience and Resistance Measures	y	y	y	y	y	y	y	y	y	y	y

With **y** - There are opportunities for implementation of this mitigation measures within the CDA. Measure should be considered in the Options Assessment; **o** - 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; and **n** - There are no opportunities for implementation of measure within CDA

4.3 Options Assessment

4.3.1 Long List of Potential Options

A long list of options was developed for each CDA based on the measure opportunity assessment, the updated SWMP Phase 2 outputs and the Highway Green Infrastructure Potential Map developed by LBL[26]. This list is included in Appendix E.

The purpose of this list was to inform discussions with stakeholders and partners, to assess which of those options should be prioritised and taken forward to form the options short list.

This list presents the wider benefits and opportunities of each option, as well as their risks, limitations and estimated costs.

Methodology

The following general outputs and tools were used to develop the long list of options:

Measure Opportunity Assessment
This assessment highlighted suitable measures for each CDA and its outputs are presented in Table 9 above.

SWMP Phase 2 Outputs
The Risk Assessment presented the flood mechanisms for each CDA, highlighting the source of surface water flood risk, key flow paths and depths of flooding thus identifying the source-pathway-receptor routes to base the Options Assessment on. Areas with the greatest potential property damages due to surface water flooding were assessed in priority.

Discipline Specific Assessments
Discipline specific assessments were undertaken to identify opportunities within the Borough's highways, estates and parks. Schemes in those areas are more likely to provide wider benefits than flood mitigation, be eligible for several sources of funding and can be incorporated into the Borough's future planning. The tools and factors taken into consideration for these assessments are presented in the section below.

Discipline Specific Considerations

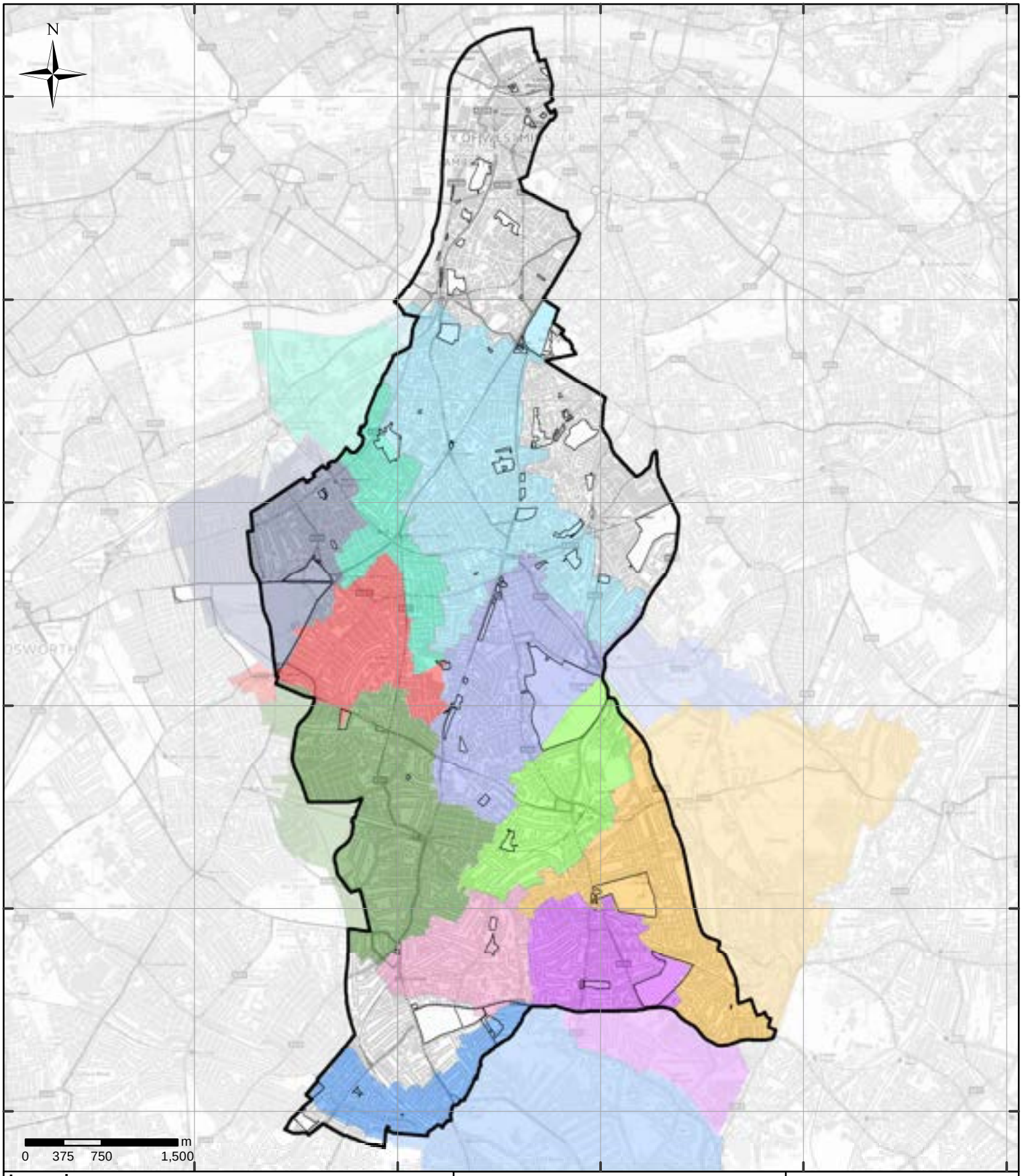
Parks
The LBL hosts numerous parks, as shown in Figure 24, which provide large spaces of permeable ground, enabling surface water to partially infiltrate into the ground. As such parks should be considered in flood mitigation schemes to attenuate runoff from their own footprint as well as, where possible, from neighbouring impermeable surfaces. Such measures can help reduce runoff at source, in the upper parts of the catchment, or provide storage and attenuation for runoff in the lower parts of the catchment.

When developing potential options within parks, the following factors were taken into consideration:

- Spatial requirements within parks for areas to be used for events and public exercise;
- Anticipated increased usage of green open spaces and parks following the Covid-19 pandemic putting pressure on existing "usable" space by members of the public;
- Public perception of ground being rendered "soggy" and inaccessible during wet winter months;
- Drive to increase biodiversity within parks and green areas by installing meadow like features;

[26] London Borough of Lambeth, Highway Green Infrastructure Potential Map GIS Tool, 2021.

- Drive to ensure parks do not encourage antisocial behaviour by providing areas which are continuously damp or hidden away (through use of bunds for example);
- Accessibility of parks to all members of the public; and
- Lack of funding and resources to support regular maintenance of flood mitigation assets.



Legend

- Borough Boundary
- LBL Owned Parks
- Clapham CDA
- Herne Hill CDA
- Oval CDA
- Railton Road CDA
- South Lambeth CDA
- Streatham CDA
- Streatham Hills CDA
- Streatham Vale CDA
- Wandsworth Road CDA
- West Dulwich CDA
- West Norwood CDA

Notes:
1. This map presents the locations of the London Borough of Lambeth Parks in respect to the Critical Drainage Areas within Lambeth as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The methodology used to produce these CDAs can be found within the CDA Delineation Technical Note.
3. This map provides the CDAs as informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title
Parks located within the London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

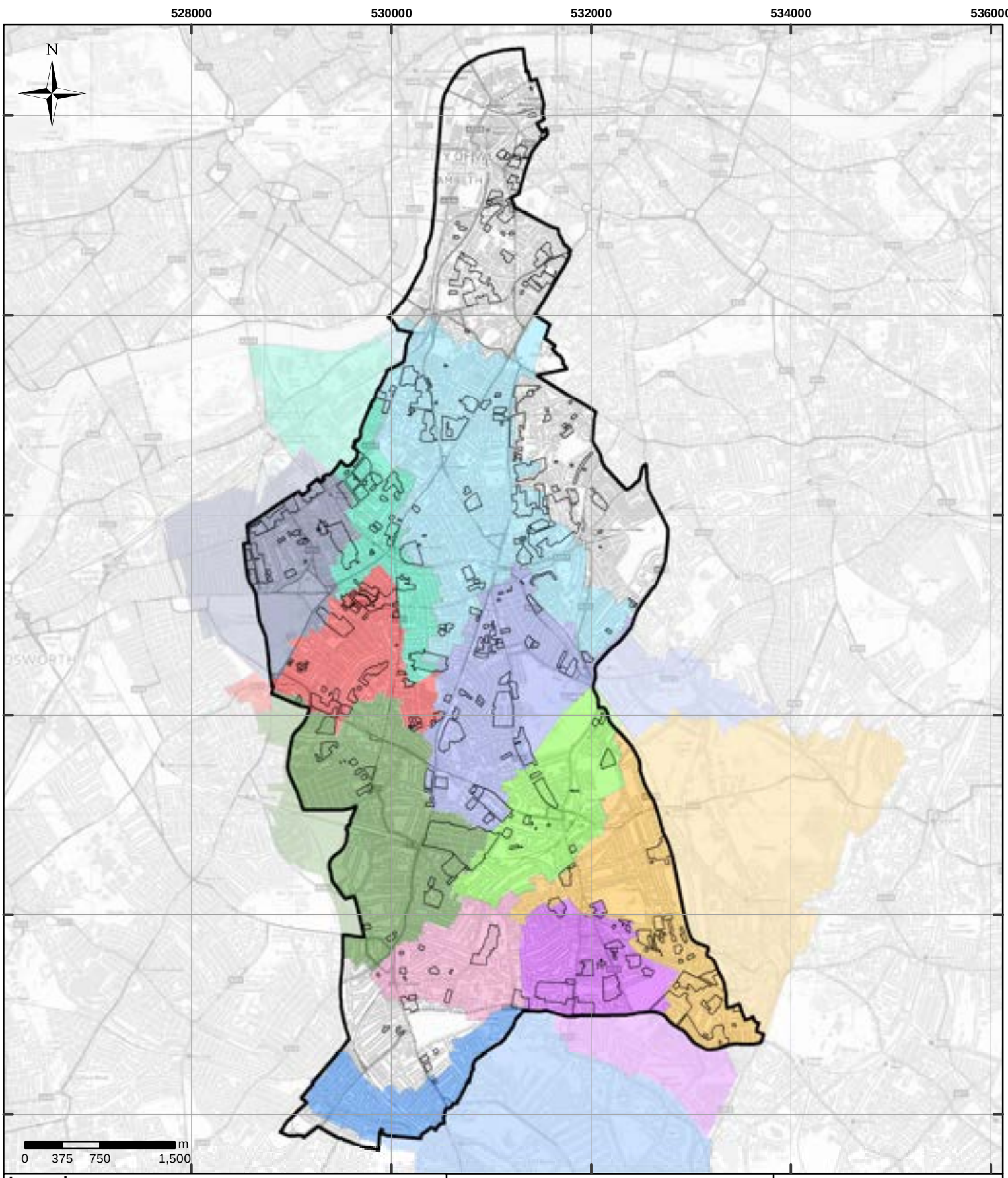
Figure 24

Housing and Estates

The LBL manages several housing estates with the Borough, as shown in Figure 25, which often have relatively large expanses of grass around them. LBL managed estates should be considered in flood mitigation schemes as they often have extensive hardstanding surfaces and large single roofs but with sufficient space to accommodate water retention within surrounding areas. Schemes on those estates can be combined with public amenity benefits and the Borough can engage directly with residents on proposed schemes. In certain parts of the Borough the density of LBL managed estates is very high, and the attenuation of surface water runoff from their footprints could therefore lead to significant increases in sewer capacity in those areas. Such measures can help reduce runoff at source, in the upper parts of the catchment.

When developing potential options within LBL managed estates, the following factors were considered:

- Reports of flooding issues around the estates;
- Drive to increase green spaces around estates;
- Drive to increase the number of trees around estates;
- Spatial requirements for car parking;
- Improved public amenity spaces for residents and drive to imitate schemes such as Caldwell Gardens which help develop communities; and
- Lack of funding and resources to support regular and long-term maintenance of flood mitigation assets.



Legend

- Borough Boundary
- LBL Owned Housing
- Clapham CDA
- Herne Hill CDA
- Oval CDA
- Railton Road CDA
- South Lambeth CDA
- Streatham CDA
- Streatham Hills CDA
- Streatham Vale CDA
- Wandsworth Road CDA
- West Dulwich CDA
- West Norwood CDA

Notes:
1. This map presents the locations of the London Borough of Lambeth estates in respect of the Critical Drainage Areas within Lambeth as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. The methodology used to produce these CDAs can be found within the CDA Delineation Technical Note.
3. This map provides the CDAs as informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title
Estates managed by the London Borough of Lambeth

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 25

Highways

Highways frequently act as conveyance routes for excess surface water and as such measures ought to be considered to attenuate water within the carriageway and the pavement. Such measures can help water being discharged back to the sewers in the upper parts of the catchment once these have recovered spare capacity and prevent accumulation at the downstream ends of the catchment where sewers take significantly longer to drain.

When developing potential options within highways, the following factors were taken into consideration:

- Spatial requirements within highways for car parking;
- Drive to incorporate “off-the-shelf” designs for flood mitigation or greening options such as swales or raingardens so they can be incorporated within the transportation strategy and easily implemented; and
- Drive to increase use of permeable paving through planning requirements for private developers and justification of wider benefits for LBL managed schemes.

In addition, the following assessments were also used:

Highway Green Infrastructure Potential Map

This tool was produced by LBL and classifies highways within the Borough based on their position within each discrete catchment. Indicative flow accumulation routes calculated using hydrological GIS tools were ranked based on the number of upstream routes feeding into them. Flow routes were generated using 2ha minimum catchment area and the Strahler Stream Order method. Highways intersecting flow routes were assigned the same rank which is then translated into the recommended type of green infrastructure or sustainable drainage system, as presented in Table 10.

Table 10 London Borough of Lambeth Highways Classification Methodology

SuDS Type	Strahler Stream Order	Description
Source Control	0 (i.e. no accumulated flow)	Roads in the upper parts of the catchment can be fitted with standard source control measures such as grassed verges which do not require engineering design to provide flood storage but seek instead to reduce direct runoff from hardstanding surfaces by replacing them with green or permeable surfaces. Such measures can provide substantial biodiversity, amenity and air quality benefits at a relatively low cost.
Site Control	1	Roads in the intermediate parts of the catchment can be fitted with site control measures, such as standard design raingardens which would seek to store the manageable volumes of water flowing through those parts of the catchment without extensive redesign of the SuDS features.
Regional Control	≥2	Roads at the downstream end of the catchment can be fitted with bespoke measures which will only seek to have a more localised impact on flood risk. These measures need to be assessed on a location by location basis and will need bespoke design.

The measures recommended in the previous table are indications of the scale and type of feature required to manage surface water sustainably and economically across the Borough. This assessment draws on the principles of:

- The SuDS Management Train (see Figure 26 below);
- Slowing the flow and preventing surface water from entering the combined sewer system in the upper catchment; and
- As runoff accumulates in the lower part of the catchment the rates and volumes of runoff are more challenging and costly to manage, especially in a dense urban environment

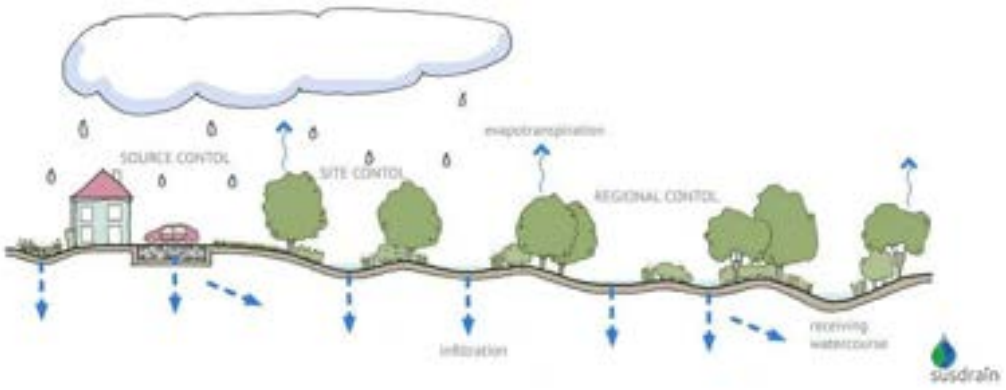


Figure 26 SuDS Management Train (Source: SusDrain[27])

In reality, the SuDS type options for carriageways and footways can be restricted by topography, spatial constraints, or conflicting traffic management requirements. In these cases, the optimal SuDS type for the location of interest should be considered in order of preference (Regional Control > Site Control> Source Control). For example if a road is considered ideal for site control SuDS but is spatially and topographically constrained, source control type SuDS can be considered instead; or, should a highway noted as ideal for regional control SuDS be constrained by traffic management, source control SuDS can be considered as more appropriate.

Figure 27 provides an example of this assessment for the area around West Norwood.

[27] SusDrain, SuDS Management Train. Accessible on: https://www.susdrain.org/delivering-suds/using-suds/suds-principles/management-train.html. Accessed April 2021.

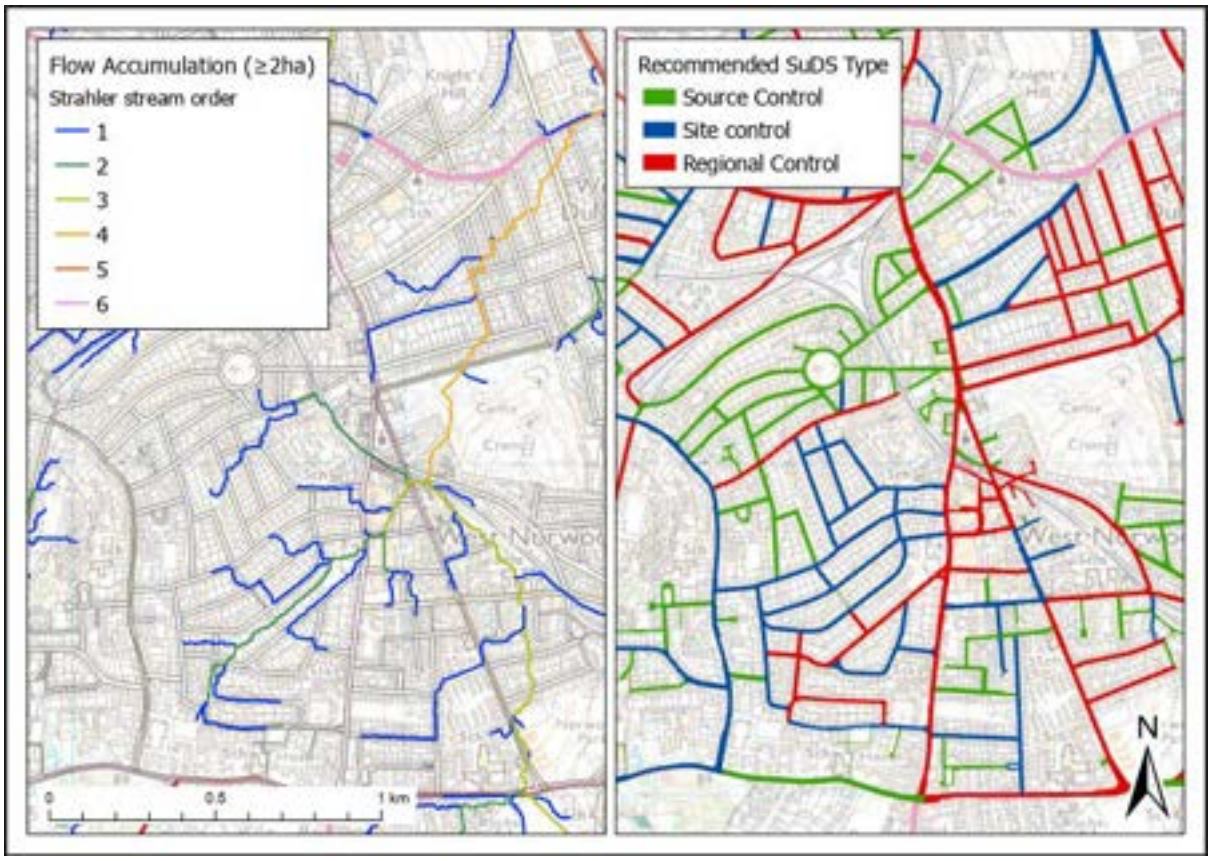
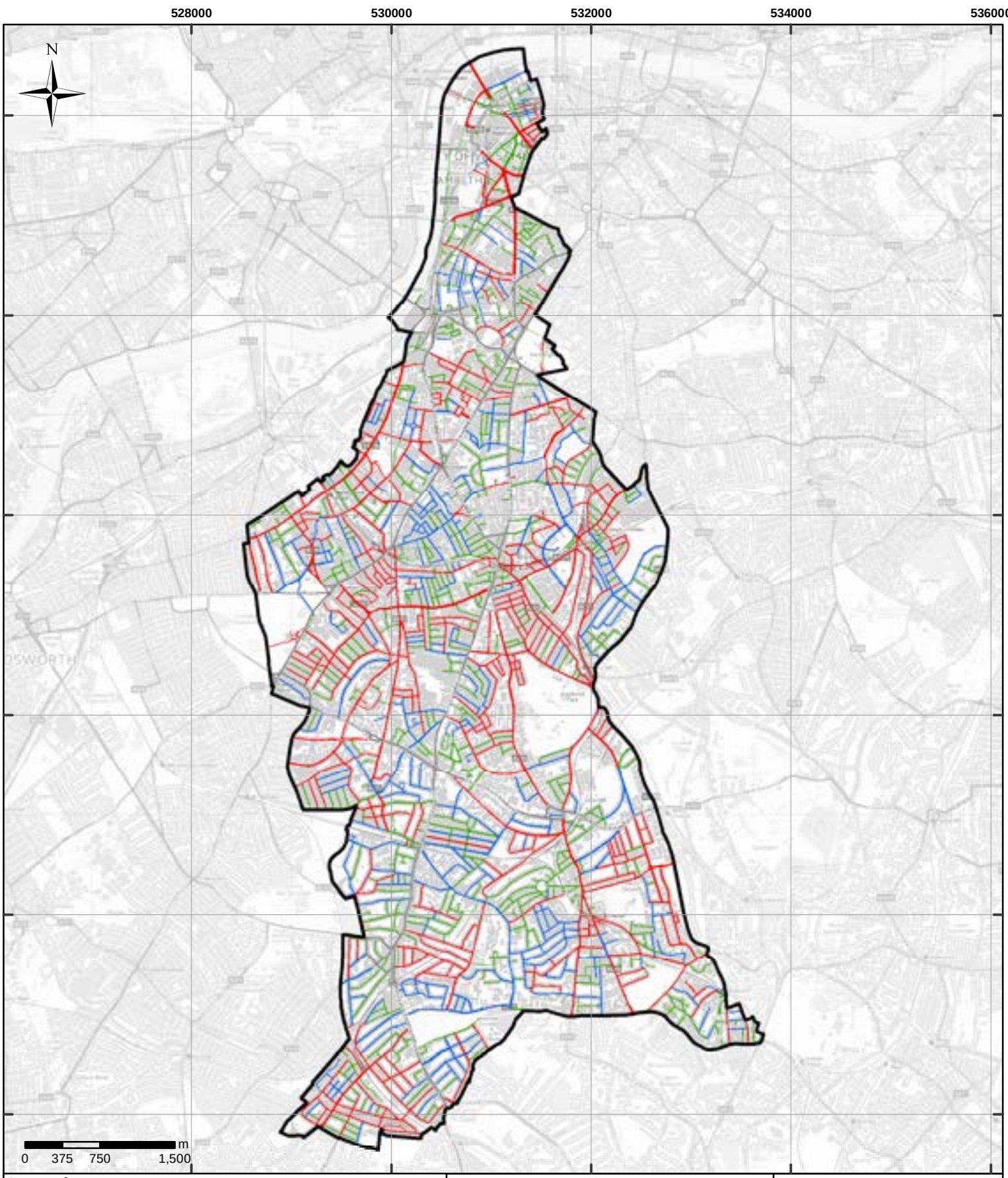


Figure 27 Example of the Highways Green Infrastructure Potential Map for the West Norwood area

Figure 28 shows the tool's output for the entire Borough. See Appendix E for the detailed map and list of highways with their recommended SuDS type.



Legend

- Borough Boundary

Scheme

- Regional Control
- Site Control
- Source Control

Notes:

1. This map presents the outputs of the Green Infrastructure Potential Map, a tool developed and owned by the London Borough of Lambeth.
2. Outputs from this tool are indicative and seek to guide design discussions rather than replace them. The potential use of SuDS along any given highway should always be discussed with the London Borough of Lambeth Flood Risk Officer.
3. As the Green Infrastructure Potential Map was developed by the London Borough of Lambeth, AECOM accepts no responsibility for the accuracy of the information presented in this tool.

Drawing Title
Green Infrastructure Potential Map produced by London Borough of Lambeth

AECOM Lambeth
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

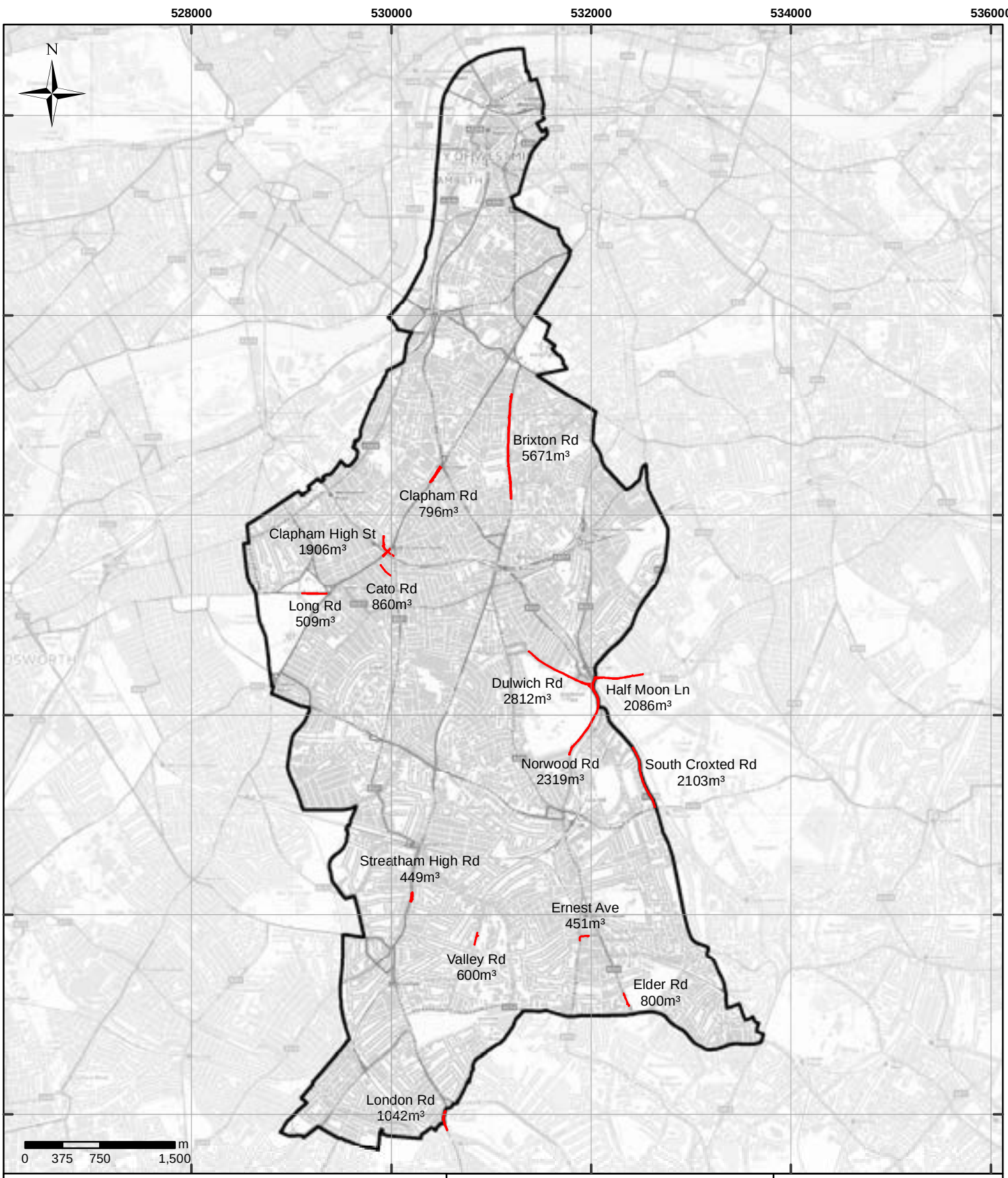
Figure 28

Highway Volume Assessment

Table 11 provides a summary of the key highways impacted by flood risk for the 1% AEP event within the LBL as well as the surface water runoff volumes conveyed within each for the 3.3% AEP, 1% AEP and 0.1% AEP. The highways are ranked based on the volume of flooding per road area (m^2) to reflect the disparities in highway sizes. The highway locations are represented in Figure 29.

Table 11 Key highways affected by flood risk within LBL

Highway Rank	Highway	CDA	Volume per road area (m^3/m^2) 1% AEP	Volume (m^3) by AEP		
				3.3%	1%	0.1%
1	**Cato Road**	Clapham	0.74	738	860	1252
2	**Elder Road**	West Norwood	0.70	711	800	1238
3	**Valley Road**	Streatham	0.57	531	600	620
4	**Clapham High Road**	South Lambeth	0.46	1503	1906	3482
5	**Ernest Avenue**	West Norwood	0.42	372	451	642
6	**Brixton Road**	Oval	0.41	3382	5671	10454
7	**London Road**	Streatham Vale	0.41	891	1042	1372
8	**Half Moon**	Railton Road	0.36	1472	2086	4232
9	**Dulwich Road**	Railton Road	0.36	1693	2812	6248
10	**South Croxted Road**	West Dulwich	0.33	1564	2103	3434
11	**Norwood Road**	Tulse Hill	0.23	1679	2319	3907
12	**Clapham Road**	Oval	0.23	555	796	1538
13	**Streatham**	Streatham Hills	0.23	381	449	750
14	**Long Road**	Wandsworth Road	0.20	475	509	601



Legend

- Borough Boundary
- Critical Highways (Maximum Flood Volume)

Notes:
1. This map presents the locations of the highways which are likely to experience the highest volume of surface water flooding as predicted by the updated Lambeth SWMP hydraulic model prepared for the London Borough of Lambeth.
2. This map provides an overview of surface water flood risk informed by best available data at the time hydraulic modelling was undertaken. Results may be subject to change as new datasets become available and further analysis undertaken.

Drawing Title: **Key highways affected by flood risk within the London Borough of Lambeth for the 1% AEP storm event**

AECOM
Sunley House, 4 Bedford Park
Croydon, Surrey, CR0 2AP
Tel: +44 (0) 208 639 3500
www.aecom.com

GIS:	Checked:	Approved:
BG	MGI	DG

Scale at A4: 1:50,000
Scale at A3: 1:35,000
Scale at A1: 1:17,500

Date: 21/04/2021

Purpose of Issue: For Issue

Client: London Borough of Lambeth

Project Title: London Borough of Lambeth Surface Water Management Plan

Figure 29

Benefits

To ensure the options developed were in line with LBL's wider planning strategy, a list of benefits was prepared in collaboration with LBL. Proposed options must seek to:

- Contribute to a reduction in surface water runoff within the catchment;
- Directly benefit properties currently at risk of flooding;
- Improve the quality of surface water runoff discharge;
- Provide opportunity to increase or support local biodiversity;
- Provide wider public amenity benefits of cultural, educational or leisure value;
- Support the development of active travel measures and corridors; and,
- Include green infrastructure.

Costs

A high-level cost estimate was also produced for each option. These were prepared based on engineering judgement and have been presented in the cost bands provided by Drain London[18]. These high-level estimates have only accounted for the approximate capital cost of each scheme and have made no allowance for costs associated with any site-specific constraints, design or maintenance.

4.3.2 Short List of Potential Options

Methodology

The SWMP seeks to present a short list of options which should be incorporated into Lambeth's Climate Adaptation Strategy. To reduce the long list of options into a shorter list, Workshops were organised with the different planning sectors within LBL (Highways, Estates and Housing and Parks) as well as neighbouring boroughs (LBS) in March 2021 to discuss options included in the long list. Following the workshops, a scoring system was established to help prioritise each option based on its perceived wider benefits and its compatibility with the LBL planning priorities, as established during the workshops.

This scoring system is presented in Figure 30. The scores attributed to each option can be found in Appendix E. Schemes which were scored as "Very High" using this approach were incorporated into a short list of options. Short-listed options can be divided into two categories: borough-wide options and CDA specific options.

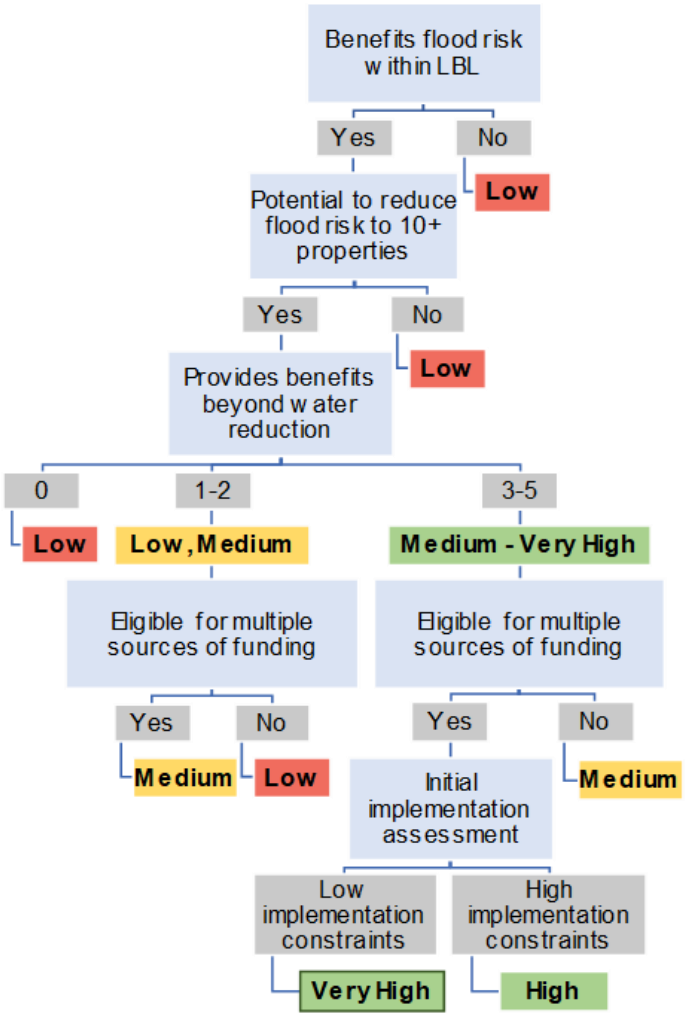


Figure 30 Scoring System established to compare the updated SWMP Long List of Options

Borough-wide Recommendations

The options assessment identified schemes which were common to several CDAs and should therefore be considered across the entire Borough. In addition to short-listed options this section also contains recommendations specific to certain LBL disciplines which were discussed during the workshops. These recommendations seek to support the inclusion of SuDS within the overall LBL planning process.

Finally, reference has also been made to Borough-wide recommendations included in the 2011 SWMP which were still deemed relevant. The LBL and relevant stakeholders may consider adopting these as part of their responsibility as LLFA for local flood risk management.

CDA Specific Options

Options identified to mitigate and alleviate flooding within specific CDAs, tailored to the flooding mechanisms of each catchment. It is expected that those options will be further investigated by the LBL as further information becomes available, whether through on-site investigations and/or third-party collaborations. It should be noted that collaboration between stakeholders (Boroughs, disciplines, Thames Water and local organisations) will be required for most of these schemes. Details of options falling within both categories can be found overleaf.

Borough-wide Options	Planning and Development Policies
Stakeholders and Partners	LBL Planning Team, LBL Housing and Estates Team, LBL Highways Team, LBL Transport Team

Permeable Driveways and Gardens

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 LBL should publicise this issue and refer to standard guidance on the surfacing of front gardens provided by the Communities and Local Government and Environment Agency in September 2008.

Figure 31 Examples of Permeable Front Gardens Allowing for Parking (Source: CLG/EA Guidance on the permeable surfacing of front gardens 2008; Richmond Scrutiny Report 2008)

LBL_01: Ensure appropriate Development Control Policy for repaving of gardens or driveways and explore education and awareness opportunities for general public regarding SuDS guidance and 'best practice'.

This can be achieved through the following:

- LBL could encourage residents to ensure that paved areas in front gardens drain onto flower beds rather than running onto the highway
- LBL could aim to raise awareness of the options for installation and maintenance of permeable surfaces within property grounds in the early stages of the planning application process. For new driveways, this should be undertaken as applicants submit a request for a new dropped kerb to the Transport Team.
- LBL 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.
- LBL could aim to educate/train their staff to ensure that planning officers:
    - are aware of the existing planning permissions, guidance and best practice;
    - can educate the public if enquiries are made regarding planning permission to change their drive/garden; and

Borough-wide Options	Planning and Development Policies

- can identify/enforce for non-compliance or non-permitted conversion (particularly in CDAs where it exacerbates the problem).

Sustainable Drainage Systems (SuDS)

Several policies have already been implemented within the London Borough of Lambeth to ensure that new development incorporates SuDS wherever possible. It is recommended that those policies are reviewed and updated where necessary in light of national planning policy updates, and that they should be incorporated into the LBL's Climate Adaptation Strategy.

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. Refer to the SuDS Manual[28] for further details on the types of SuDS available.

LBL_02: LBL should seek to incorporate SuDS within traffic calming measures as and when they are developed. These measures should be designed so that surface water runoff from the carriageway can be routed through the SuDS scheme and attenuated prior to infiltrating into the ground or being discharged at a reduced rate into the sewer network.

LBL_03: LBL should seek to attenuate surface water runoff emanating from LBL managed estates to greenfield runoff rates and combine this with planned improvement works. This could be achieved through the use of blue/green roofs, routing surface water runoff and roof downpipes through raingardens, swales, attenuation basins or below ground-attenuation. This option could help reduce pressure on sewer networks across the Borough and provide wider biodiversity, water quality and public amenity benefits to residents.

LBL_04: LBL should consider referring to the Highway Green Infrastructure Potential Map GIS Tool[26] when planning highway works within the Borough to identify opportunities to incorporate flood retention measures where most appropriate. Early engagement between the LBL disciplines could help optimise funding sources and improve permeability within the Borough.

[28] CIRIA, The SuDS Manual (C753), November 2015.

Borough-wide Options	Water Conservation
Stakeholders and Partners	Thames Water

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

The potential for the use of rainwater should be jointly led by Thames Water 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.

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 32:

• 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

Borough-wide Options Water Conservation

• Expected pay-back time 5.3 years (based on Southern Water 2006 tariff)

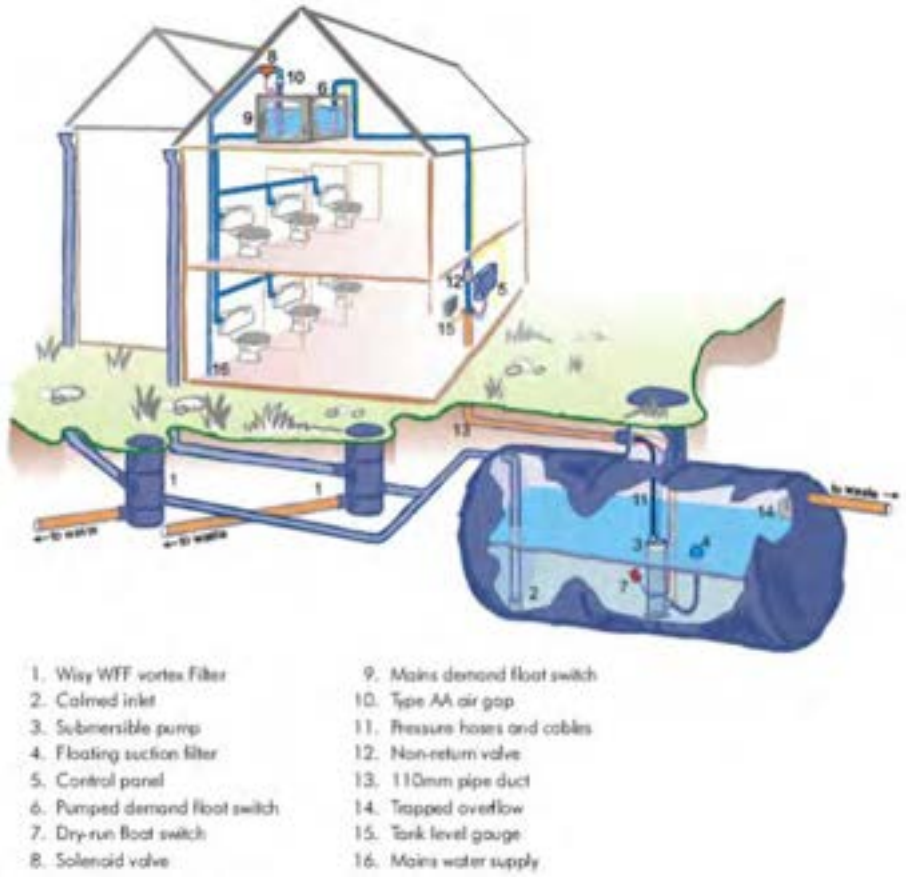


Figure 32 Example Rainwater Harvesting System in a Commercial Property (Source: Rainwater harvesting systems UK)

LBL_05: Consider opportunities to promote rainwater harvesting in both new and existing development throughout the LBL.

This can be achieved through the following:

- Providing an incentive scheme for the use of rainwater harvesting systems across the Borough. This may be linked to the Borough's sustainability checklist.
- Retrofitting rainwater harvesting systems on LBL owned properties, such as schools, for example, which offer educational opportunities as well as local surface water flood mitigation.
- Exploring 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

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 LBL, and where possible and higher surface water flooding risk has been identified, retrofitting these to existing properties. Given the constraints associated with infiltration in much of the Borough, the wholesale implementation of water butts can significantly reduce peak discharges.

Borough-wide Options Water Conservation

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 (where geology permits) or landscaped areas to ensure that there is always a volume of storage available.

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; this will have only minor significance on the proposals with respect to the surface water drainage.

Figure 33 Example of a 100L water butt retrofitted to existing development

LBL_06: Consider opportunities to promote use of water butts in both new and existing development throughout the LBL.

This can be achieved through the following:

- Considering 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.
- Considering retrofitting water butts on all existing development (as shown on Figure 33). This provides supplementary benefits beyond regeneration and redevelopment sites (volumetric reduction with opportunity for complimentary water quality improvements). There are however currently no available incentives to encourage homeowners to install water butts.
- Promoting the use of water butts across the Borough and provide information (either directly or through links to external websites) on potential costs, installation and benefits.

Borough-wide Options	Improving Resilience to Flooding
Stakeholders and Partners	N/A

One method to reduce the risk of surface water flooding to properties is raising property thresholds. Raising the threshold of entrances to property land, i.e. where there are currently gates adjacent to paved walls (Figure 34 may offer flood resilience benefits, especially where the property contains a basement. Property level thresholds could also be increased where possible to improve resilience to surface water flooding, and especially where roads are predicted to flood and the properties contain no front gardens (Figure 34).

Thresholds as shown in Figure 34 are a useful and an accepted method of defending property against flooding, although 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). Until such time as national guidance or best practice is available Lambeth will, when required, work with residents to realise suitable, sensible and cost-effective solutions which allow access and deliver mitigation against possible flooding.

Figure 34 Example of raised property threshold (gate threshold on Dulwich Road and property threshold on Robson Road, LBL)

LBL_07: Consider opportunities to promote awareness of property level thresholds throughout the London Borough of Lambeth, particularly in area of higher flood risk.

This can be achieved through the following:

- Raising the awareness of the options for increasing property thresholds
- Working 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 roads / properties are known / identified to be susceptible to surface water flooding.

Borough-wide Options	Raising Community Awareness
Stakeholders and Partners	LBL Parks Team, LBL Housing and Estates Team

A 'quick win' action that should be implemented in the short-term is to increase awareness of flooding within communities at risk, and across the Borough as a whole.

LBL_08: Consider and implement options for raising community awareness including letter drop, public meeting and/or provision of informative signs.

This can be achieved through the following:

- Undertaking a letter drop to highlight the improvement works that have been implemented as well as future planned works;
- Holding a public meeting 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 LBL – on the work that is being undertaken and who is responsible. Such a meeting should also outline how residents can help themselves and highlight their responsibility for maintaining private drainage, soakaways, driveway drainage etc.
- Considering preparing a Community Flood Plan for those communities identified to be at high risk.
- Provision of informative signs adjacent to SuDS features already in place across the Borough to familiarise residents with their function and encourage maintenance and care of those features.

Borough-wide Options	Ongoing improvements to maintenance of drainage networks
Stakeholders and Partners	LBL Parks Team, LBL Highways Team, Thames Water, TfL, Network Rail, Environment Agency

The management and maintenance of urban drainage network in the LBL is the responsibility of a number of organisations:

- LBL – highway drainage including gully pots, non-main river channel maintenance and surface water;
- Thames Water - main sewers and lateral sewers;
- Environment Agency - flood risk management assets including culverts, raised defences, trash screens, Main River channel;
- TfL – highway drainage along the 'Red Routes'; and
- Network Rail - railway drainage.

Effective cleansing of gully pots is fundamental to the drainage across the Borough and LBL operates a regular maintenance regime for gully cleansing. We understand that there are approximately 15,500 road drainage gully pots on Public Highways within the Borough boundaries. Gully pots are fundamental to integrated urban drainage in that during intense precipitation events, surface water runoff is routed off roadways and other hard-standing and into gully pots and then into the public sewer system. In essence, gully pots are a critical link in the performance of the overall drainage network

A summary of the identified drainage maintenance issues in the LBL are:

- Level of Service - The current LBL Highways Team maintenance cycle is on a 1-year maintenance regime for cleaning gully pots.
- Development Pressures and Urban Creep - During site visits, the conversion of front gardens to paved areas for car parking was observed. This gradual increase in hardstanding (impervious area) results in cumulative impacts and additional pressure on the drainage system to cope with increased runoff.

LBL_09: Consider opportunities for ongoing improvements to the maintenance of the drainage network.

This can be achieved through the following:

- Painting gullies know to flood in yellow to encourage residents to check if they are blocked and to avoid parking directly over them thereby preventing access for gully clearing team.
- Encouraging gully cleansing contractors to use powers to enforce movement of parked cars to ensure all gullies are regularly cleared.
- Coordinating 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.
- Focusing attention on the maintenance of gully pots in the identified CDAs which are considered to be high risk.
- Building on existing gully database to develop a GIS database of all Council-owned flood / drainage assets (in line with FWMA 2010 requirements).

Borough-wide Options	Ongoing improvements to maintenance of drainage networks

- As LLFA, the LBL 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.
- Aerating sports grounds and football pitches to reduce compaction of ground and improve infiltration potential.

CDA Specific Option	CLP_01 – Bowland Road Estate Flood Attenuation through use of SuDS
Address	Bowland Road Estate, William Bonney Estate, Nelsons Row, SW4
CDA	Clapham
Stakeholders and Partners	LBL Housing and Estates Team, Thames Water

Option Description

Modelling for this area shows that flows arising from Clapham Common and the Lambeth Academy flow towards the north-east, through several LBL managed estates such as Bowland Road Estate, William Bonney Estate and Nelsons Row Estate, towards Clapham North. Sewers are at capacity in the 3.3% AEP event and surface water runoff is mostly conveyed through the carriageway, flooding properties along the way.

The estates mentioned above are located in the upper parts of the catchment, along this main flow path (the “pathway”) have long-standing records of flooding and water ponding within open spaces around the buildings. They also provide open space in this catchment and are therefore well suited to provide flood attenuation for this flow path, to reduce the amount of water eventually reaching Cato Road and Clapham North.

This reduction would be achieved by routing the flow path currently conveyed through Clapham Park Road and Bowlands Road into swales designed within the open green space around each of the estates (approximately 850m^3 of flood storage could be provided assuming a swale depth of 0.5m around these estates). Walls along the side of Bowlands Road should be removed to allow water to flow naturally into those green features, and existing raised planters should be lowered to ground level to provide further attenuation.

In addition, to further reduce the pressure on the sewer network, roof drainage from all three estates should be disconnected from the sewer and down pipes routed through raingardens to be built at the foot of estate buildings. Discharge from those raingardens back to the sewer (or the swales) should be at greenfield rate.

Finally, LBL should consider making use of permeable paving for pavements around the estates, to provide further attenuation.

It is recommended that a feasibility study is undertaken to determine the viability of the potential flood storage and permeable surface sites by assessing the total storage volumes available and required on site, confirming local surface water flow paths, and assessing the cost: benefits of undertaking such a scheme.

Potential Benefits

- Potential to mitigate flood risk to properties in the Clapham North area by reducing surface water runoff from the upper parts of the catchment.
- Addressing historical concerns from residents with localised ponding and resulting dampness around the estates.
- Contributing towards increasing biodiversity and green extents in an otherwise heavily urbanised part of LBL.
- Potential to provider broader public amenity benefits by creating communal garden spaces around the swales and raingardens. Community activities could be developed around those schemes to enable residents to engage with the project.

CDA Specific Option	CLP_01 – Bowland Road Estate Flood Attenuation through use of SuDS

- Potential to combine scheme within wider LBL planning strategy, which could lead to efficiencies in funding.

Approximate Costs	£101k - £250k

Figure 35 Bowland Road Estate (view from Bowland Road) and Clapham Crescent

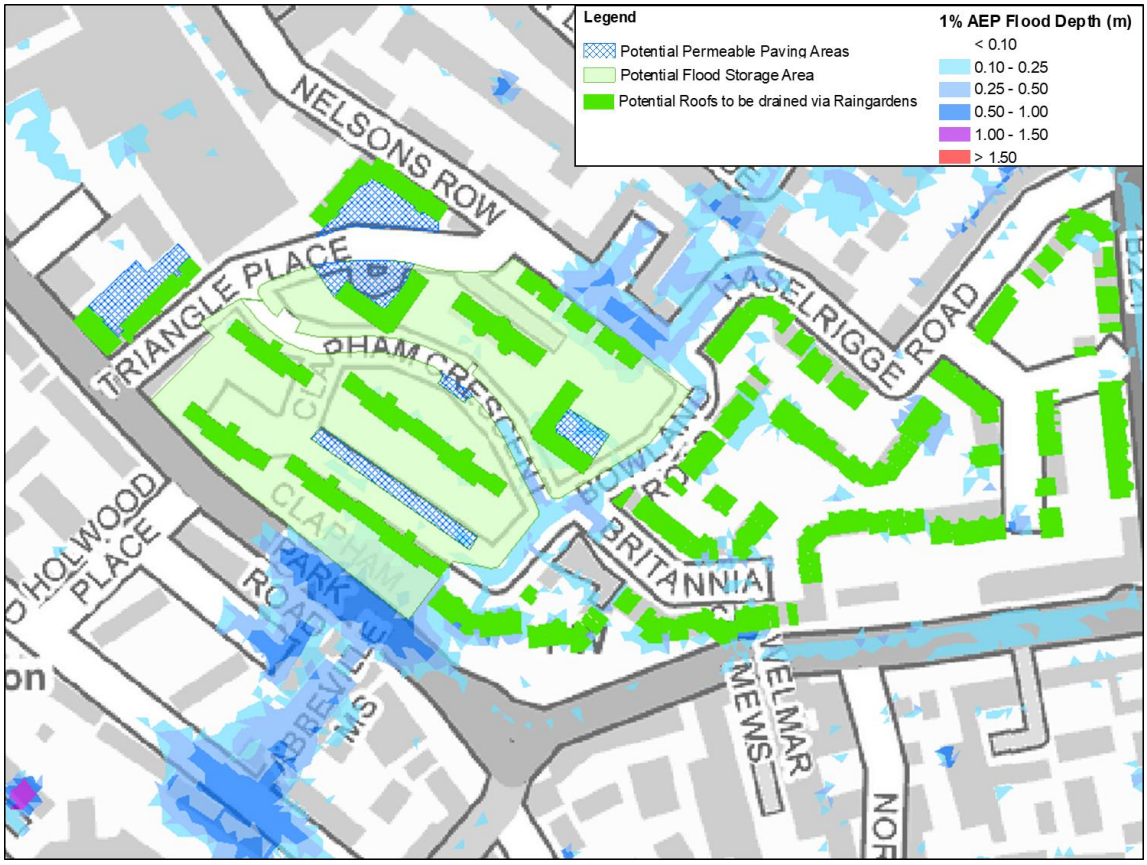


Figure 36 Indicative flood storage areas around the Bowland Road Estate

CDA Specific Option	CLP_03 and CLP_05 – Cato Road Flood Alleviation through use of SuDS and below-ground storage
Address	Cato Road and Kendoa Road, SW4
CDA	Clapham
Stakeholders and Partners	LBL Highways Team, Thames Water

Option Description

Modelling for this area shows that the Cato Road area is at the downstream part of the Clapham CDA. Surface water runoff arising from Clapham Common and from surcharging sewers between Clapham Park Road and Kenwyn Road accumulates within Cato Road prior to discharging into the Clapham High Street sewer.

Runoff conveyed within the carriageway overtops the pavement along Kendoa Road and enters property back gardens between Kendoa Road and Cato Road, putting these properties at risk of flooding. Water remaining within the carriageway also drains towards Cato Road.

To mitigate flood risk to those properties, a two-fold approach is proposed:

- Pavement height along Kendoa Road should be raised to prevent water from overtopping and entering properties. This option would lead to an increase in water being conveyed within the carriageway towards Cato Road.
- To mitigate the increase of water within Kendoa Road and Cato Road and prevent increasing risk to properties along Cato Road due to this, flood attenuation measures should be incorporated within the pedestrian area at the corner between Cato Road and Kendoa Road.

These measures should include a combination of green infrastructure such as raingardens and tree pits, permeable paving and below-ground attenuation (approximately 250m^3 of flood storage could be provided assuming a storage depth of 1m).

It is recommended that a feasibility study is undertaken to determine the viability of the potential flood storage by assessing the total storage volumes available and required on site, refining the representation of the local sewer system (confirming gully locations for example), identifying constraints such as utilities and assessing the cost: benefits of undertaking such a scheme.

Potential Benefits

- Potential to mitigate flood risk to properties between Cato Road and Kendoa Road by preventing water from entering back gardens and attenuating the displaced water.
- Contributing towards increasing biodiversity and green extents in an otherwise very urban part of LBL.
- Potential to provide broader public amenity benefits and transport corridors by developing safe and green routes between major roads.

Approximate Costs	£101k - £250k

CDA Specific Option	CLP_03 and CLP_05 – Cato Road Flood Alleviation through use of SuDS and below-ground storage


Figure 37 Kendoa Road and Cato Road pedestrianised area

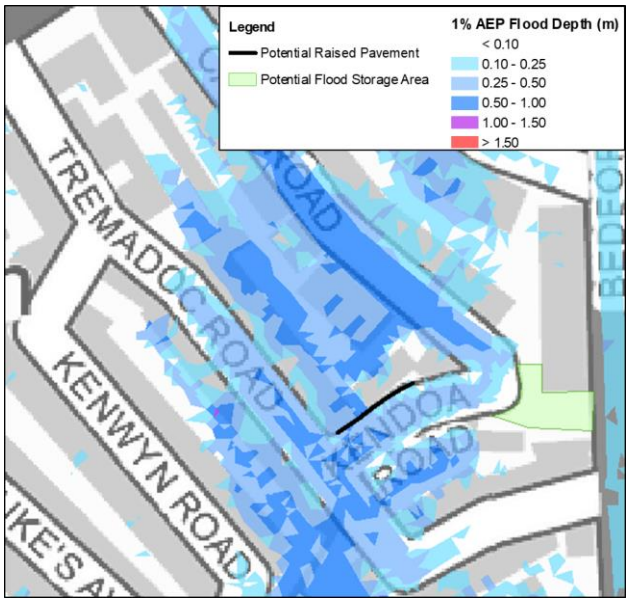


Figure 38 Proposed raised pavement and flood storage area by Cato Road

Figure 39 Example of green infrastructure providing flood storage in a pedestrian environment (Source: SusDrain[29])

[29] SusDrain, SusDrain Photostream. Available at: https://flic.kr/ps/38jzth . Accessed April 2021.

CDA Specific Option	RAR_02 – Railton Road Traffic Calming Measures
Address	Railton Road, SE24
CDA	Railton Road
Stakeholders and Partners	LBL Highways Team, Thames Water

Option Description

Railton Road is located at the downstream end of the Railton Road CDA catchment, with surface water runoff accumulating in a natural low point between Railton Road and Mayall Road. Sewers are surcharging in this part of the CDA and excess water continues to flow north towards Brixton.

To mitigate flood risk to properties around Mayall Road, LBL should seek to intercept surface water runoff along its main pathway: Railton Road as well as adjacent roads such as Chaucer Road, Effra Parade and Barnwell Road. With the understanding that this area is under consideration by the LBL Highways Team to incorporate traffic calming measures, it is proposed that flood storage such as raingardens are incorporated within this strategy.

Depending on the arrangements to be put in place by the Highways Team, a combination of the following designs should be considered:

- Raingardens to be incorporated within traffic calming measures, at ground level, to capture surface water runoff from the carriageway and pavement. Runoff entering the raingardens should be attenuated to greenfield rate prior to being discharged back to the sewer network.
- Swales within extended pavements: Railton Road is proposed to become one-way only for most traffic with only buses able to travel in both directions. This proposal is expected to lead to a significant reduction in traffic volume which would enable narrowing of the carriageway to incorporate such a scheme. Widening of the pavement could be considered along the length of Railton Road, between Leeson Road and Kellett Road, with swales built into the widened space.

It is recommended that engagement with the Highways Team is undertaken to confirm the changes expected to road layout in this area and assess the potential to extend this to a larger part of the CDA.

A feasibility study should then be undertaken to determine the viability of the potential flood storage by assessing the total storage volumes available and required on site, identifying constraints such as utilities and assessing the cost: benefits of undertaking such a scheme.

Potential Benefits

- Potential to mitigate flood risk to properties between Railton Road, Mayall Road and Bob Marley Way by attenuating water upstream of those properties and reducing the amount of surface water runoff reaching them.
- Contributing towards increasing biodiversity and green extents within LBL.
- Potential to combine scheme within wider LBL planning strategy, which could lead to efficiencies in funding.

Approximate Costs	£101k - £250k

CDA Specific Option RAR_02 – Railton Road Traffic Calming Measures

Figure 40 Railton Road Traffic Reduction Scheme

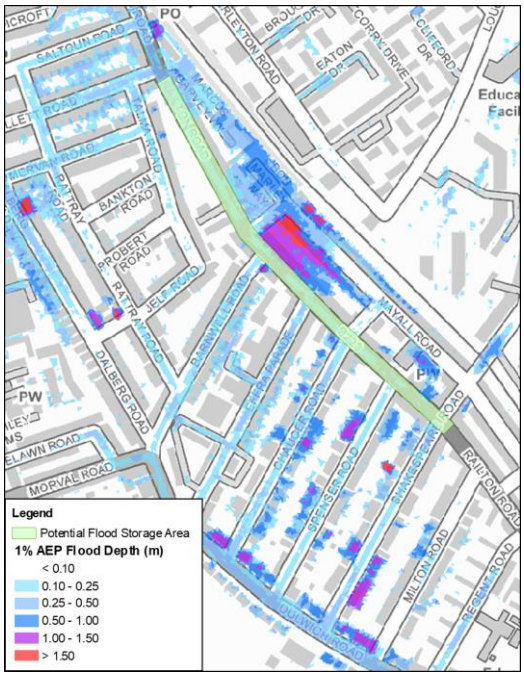


Figure 41 Proposed segment of Railton Road for incorporation of SuDS

Figure 42 Example of SuDS incorporated in traffic calming measures and extended pavements (Source: SusDrain[29])

CDA Specific Option	SLB_01 –Solon Estate Roof Disconnections
Address	Solon Estate, Bedford Road, SW4
CDA	South Lambeth
Stakeholders and Partners	LBL Housing and Estates Team, Thames Water

Option Description

The Solon Estate is located in the upper parts of the South Lambeth CDA. Flooding mechanisms in this CDA are associated with surcharging sewers in streets adjacent to Bedford Road, flowing into Bedford Road and towards Clapham North and the Larkhall Park area. The surface water sewer along Kepler Road is one of those surcharging sewers, with surcharged water in Kepler Road crossing the Solon Estate to discharge into Bedford Road.

This option proposes to intercept this excess runoff at source, which is highly desirable in flood risk management as the benefits have the potential to impact a far larger number of properties than schemes in the downstream parts of the catchment.

The Solon Road Estate benefits from large green areas around each of the buildings which are not currently landscaped. To reduce the pressure on the sewer network, roof drainage from all buildings in the estate should be disconnected from the sewer and down pipes routed through raingardens to be built at the foot of estate buildings. Discharge from those raingardens back to the sewer should be at greenfield rate.

The LBL should also consider landscaping the remaining green spaces such that they may provide further attenuation to remaining surcharged water from the Kepler Road sewer. Swales or shallow undulating ground in the space around Bedford House would enable this excess water to partially infiltrate leading to a reduction in runoff discharging into Bedford Road. It is estimated up to 400m^3 flood storage could be provided in this way (assuming a storage depth of 0.5m).

It is recommended that a feasibility study should be undertaken to assess the impact of roof disconnections and flood storage within the Solon Estate on the South Lambeth CDA. This should help inform the cost: benefits of such a scheme as well as its viability.

Potential Benefits

- Potential to mitigate flood risk to properties across the South Lambeth CDA by reducing discharge to the sewer and attenuating surface water runoff at source.
- Contributing towards increasing biodiversity and open space within LBL.
- Potential to provider broader public amenity benefits by creating communal garden spaces around the raingardens. Community activities could be developed around the raingardens to enable residents to engage with the project.

Approximate Costs	£101k - £250k

CDA Specific Option SLB_01 –Solon Estate Roof Disconnections

Figure 43 Green areas around the Solon Road Estate

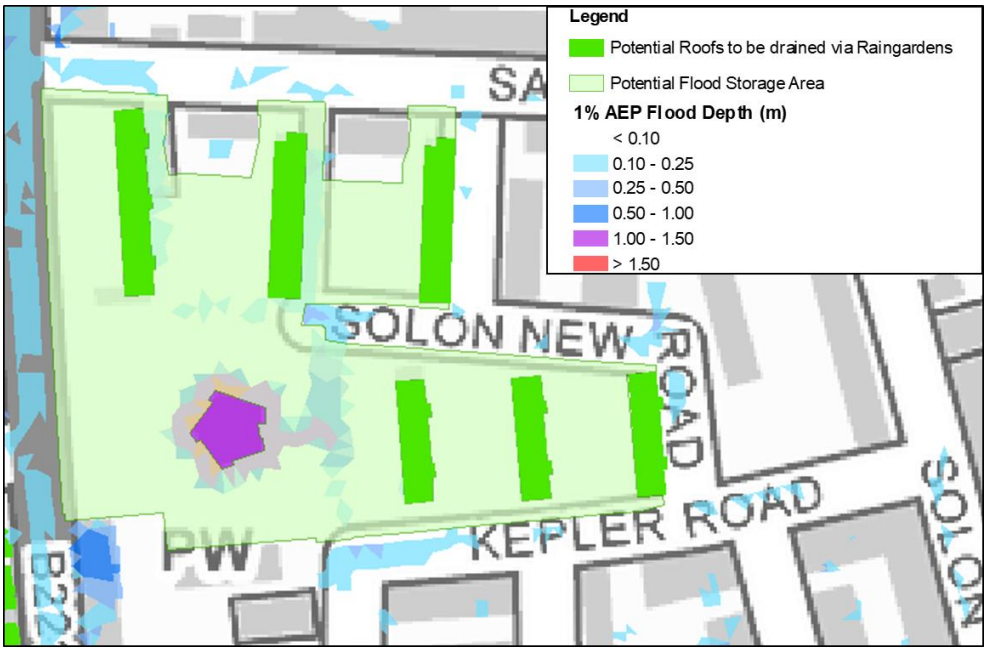


Figure 44 Indicative areas for flood storage and roof disconnections around the Solon Estate

Figure 45 Example of roof disconnections draining into raingardens (Source: SusDrain[29])

CDA Specific Option	SLB_07 – Larkhall Park Swales
Address	Larkhall Park, SW4
CDA	South Lambeth
Stakeholders and Partners	LBL Parks Team, Thames Water

Option Description

Larkhall Park is located in the downstream part of the South Lambeth CDA and is along the major surface water flow route connecting the upper and lower parts of the catchment.

The park provides an opportunity to attenuate some of the runoff prior to it reaching properties along Wandsworth Road, the area with most properties at risk of flooding within the CDA.

Surface water runoff within Courland Grove should be routed along the park's western border through the use of swales (approximately 100m^3 of flood storage could be provided, assuming a swale depth of 0.5m), accommodating the presence of existing trees. Storage provided within the swales has the potential to reduce the runoff reaching Wandsworth Road.

The LBL should also assess the potential to provide attenuation within the vacant space located between the playground and Courland Grove. It is understood that reports of flooding within the playground were conveyed to the LBL. Provision of informal attenuation through regrading land to form a natural low point could mitigate this risk whilst also (and mainly) contributing to reducing surface water runoff towards Wandsworth Road. It is estimated this space could provide up to 300m^3 additional flood storage (assuming a depth of 0.5m).

Following engagement with the LBL Parks Team it is understood there is a desire to increase biodiversity within Larkhall Park and that proposals are already under consideration to plant meadow like fields.

It is recommended that engagement with the LBL Parks Team is continued to confirm the space available for such a scheme.

A feasibility study should then be undertaken to assess the direct impact of this scheme to properties further downstream and inform its cost: benefits. The purpose of this assessment would be to confirm the viability of the scheme and the different sources of funding available.

Potential Benefits

- Potential to mitigate flood risk to properties Wandsworth Road by attenuating surface water runoff prior to it reaching the catchment low point.
- Contributing towards increasing biodiversity and green extents within LBL.
- Potential to align scheme with wider LBL Parks Team's proposals to improve Larkhall Park, which could lead to efficiencies in funding.

Approximate Costs	£51k - £100k

CDA Specific Option SLB_07 – Larkhall Park Swales

Figure 46 Larkhall Park on Courland Grove side and by the playground (opportunities to incorporate respectively swales and natural attenuation)

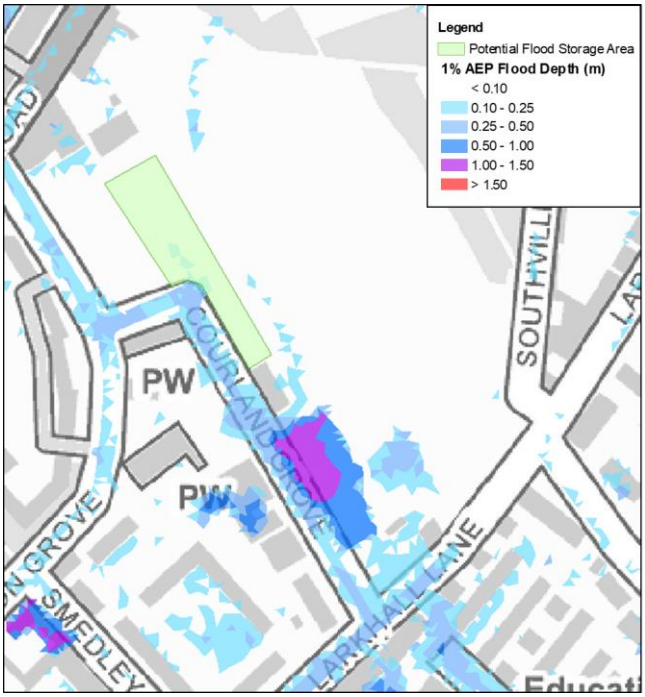


Figure 47 Indicative area for flood storage and swales within Larkhall Park

Figure 48 Example of shallow swales in parks (Source: SusDrain[29])

CDA Specific Option	SLB_10 Blore Close and Bilton House De-paving scheme
Address	Blore Close and Bilton House, SW8
CDA	South Lambeth
Stakeholders and Partners	LBL Housing and Estates Team, Thames Water

Option Description

Blore Close and Bilton House is located at the most downstream end of the South Lambeth CDA. Surface water runoff from the upper parts of the catchment, including Larkhall Park, drains towards Wandsworth Road and Thessaly Road. There, the combination of lower ground levels and limited sewer capacity leading to surcharging of the network causes water to accumulate within Thessaly Road, flooding the estates around Blore Close, including Bilton House.

Blore Close and Bilton House both currently have large extents of impermeable paving, with limited green features despite the space available.

To mitigate flood risk to those properties, surface water runoff should be managed within the vacant space available so it can be contained within the carriageway and car parking areas. Due to the high volumes of flood water in this area, the purpose of this scheme is not to remove food risk altogether but to provide enough attenuation to reduce flood risk to the estates.

This attenuation should be provided through a combination of the following:

- Removal of raised pavement areas around the sports court on Blore Close and the car parking area by Bilton House and replacing them with a combination of ground level tree pits and raingardens to capture water flowing within the carriageway. These features could be underlain with below-ground attenuation discharging at greenfield rate to optimise the flood storage potential of this scheme.
- Permeable paving to cover car parking areas, which should be underlined with below-ground attenuation to provide further temporary flood storage. This should be considered in Blore Close, by Bilton House and along the road connecting the two.

Approximately 600m^3 of flood storage could be provided across the site.

It is recommended that a feasibility study is undertaken to determine the viability of potential flood storage by assessing the total storage volumes available and required on site, refining the representation of the local sewer system (confirming gully locations within the estates for example), identifying constraints such as utilities and assessing the cost: benefits of undertaking such a scheme.

Potential Benefits

- Potential to mitigate flood risk to properties around Blore Close by providing temporary storage on site.
- Contributing towards increasing biodiversity and green extents within LBL.
- Providing public amenity benefits to residents of Blore Close and Bilton Estate by replacing grey and ageing infrastructure with green features. Community activities could be developed around the raingardens to enable residents to engage with the project.

CDA Specific Option	SLB_10 Blore Close and Bilton House De-paving scheme
Approximate Costs	£101k - £250k

Figure 49 Paved areas in Blore Close and by Bilton House to be replaced with raingardens and permeable paving.

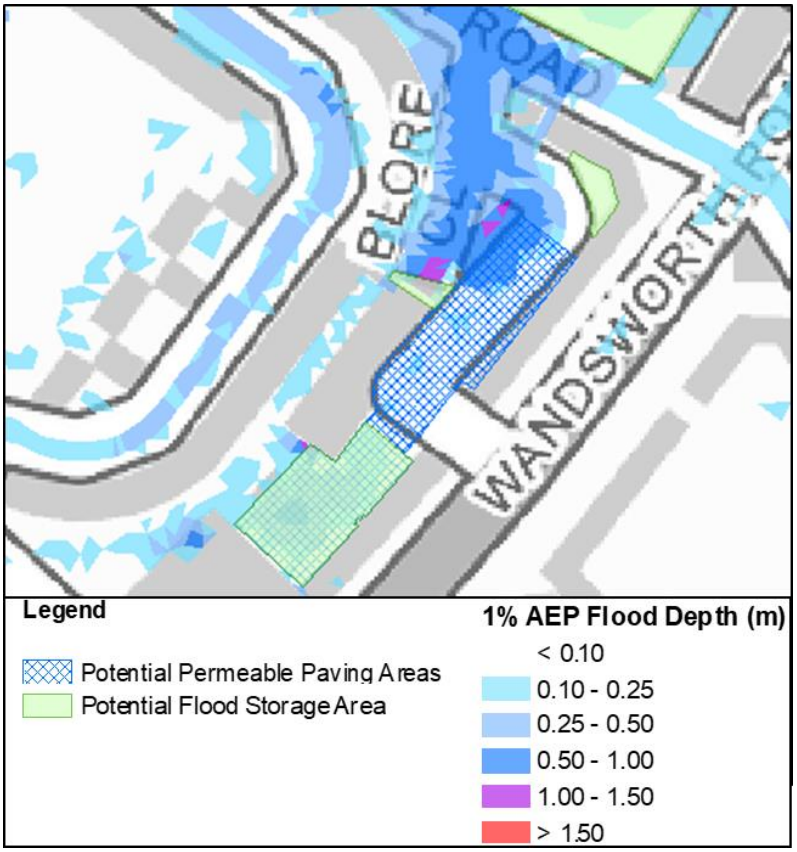


Figure 50 Indicative areas of permeable pavement and flood storage around Blore Close and by Bilton House

CDA Specific Option	SLB_12 Thessaly Road Open Space
Address	Thessaly Road open space, SW8
CDA	South Lambeth
Stakeholders and Partners	LBL Parks Team, Thames Water

Option Description

Thessaly Road is located at the downstream extent of the South Lambeth CDA. Surface water runoff from the upper parts of the catchment, including Larkhall Park, drains towards Wandsworth Road and Thessaly Road. There, the combination of lower ground levels and limited sewer capacity leading to surcharging of the network causes water to accumulate within Thessaly Road, flooding the properties in the area in both the LBL and LBW, including Blore Close and Bilton House.

A large overgrown open space area has recently been acquired by the LBL Parks Team on the northern side of Thessaly Road. Residents and the LBL have both expressed interest in redeveloping this parcel of land and making it accessible to the public. This provides an opportunity to incorporate flood storage elements and make those a key feature of the park.

It is proposed surface water runoff within Thessaly Road is routed towards the open space (using speed bumps within the carriageway or lowering/raising of kerb levels) to reduce the runoff flowing into Blore Close. Water is to be attenuated within the open space through a combination of the following measures:

- A detention basin to attenuate surface water flows during peak storm flows and discharge it at greenfield runoff rate back to the local sewer system once the storm has receded.
- Swales routing flows from the open space edges towards the flood storage basin.
- Landscaped areas including plants with higher water absorption than grassland.

It is estimated that up to 800m^3 (assuming a depth of 1m) of surface water could be stored in the green space.

It is recommended that engagement with the LBL Parks Team is undertaken to ensure flood mitigation can be a driver for the development of this space.

In addition, a feasibility study should be undertaken to determine the viability of the potential flood storage by assessing the total storage volumes available, identifying constraints such as utilities and assessing the cost: benefits of undertaking such a scheme.

Potential Benefits

- Potential to mitigate flood risk to properties around Blore Close by reducing surface water runoff into Blore Close from Thessaly Road, through provision of flood attenuation.
- Contributing towards increasing biodiversity within LBL.
- Providing public amenity benefits to residents by recreating a landscaped area to be used by the local community.

CDA Specific Option	SLB_12 Thessaly Road Open Space
• Improving public understanding of flood mitigation by showcasing the different types of SuDS used in this area using demonstration panels. This could help residents in engaging with the project.	
Approximate Costs	£51k - £100k

Figure 51 Thessaly Road open space

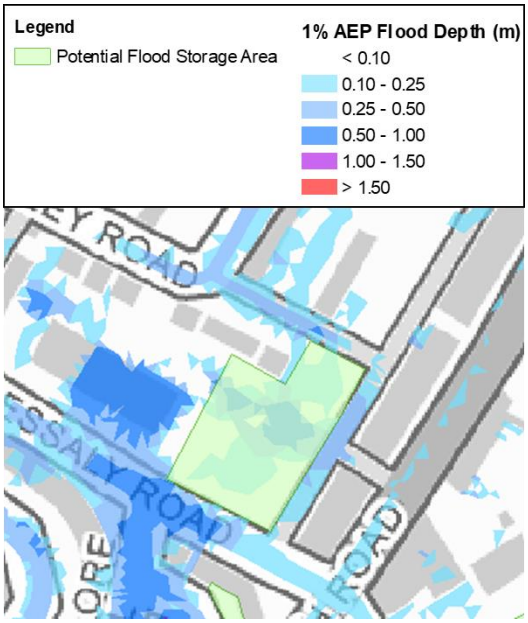


Figure 52 Thessaly Road open space and indicative flood storage extent

Figure 53 Example of detention basin within small green open space (Source: SusDrain[29])

CDA Specific Option	STR_02 Stanthorpe Close Estate Raingardens
Address	Stanthorpe Close Estate, SW16
CDA	Streatham
Stakeholders and Partners	LBL Housing and Estates Team, Thames Water

Option Description

The Stanthorpe Close Estate is located at the downstream extent of the Streatham CDA, with surface water flows arising from surcharging sewers in the upper parts of the catchment and draining towards the estate, putting it and neighbouring properties at risk of flooding. Large areas of the estate are paved with raised planters, providing little flood mitigation benefits.

It is proposed the estate's central court hardstanding areas are replaced with raingardens and tree pits, which would provide flood storage capacity for rainwater falling onto the estate, but also for runoff coming from the rest of the catchment. Below-ground storage should be provided beneath those features to increase the storage capacity of the site. Approximately 300m^3 of flood storage could be provided within the main courtyard in the form of cellular storage, assuming a storage depth of 1m, reducing the depth of flooding. This could also contribute to reducing flows from the site towards Streatham Station and mitigate flood risk to properties located along Streatham High Road.

It is recommended that a feasibility study is undertaken to determine the viability of the scheme by assessing the total storage volumes available and required to reduce flood risk to the estate, identifying constraints such as utilities and assessing the cost: benefits of undertaking such a scheme.

Potential Benefits

- Potential to mitigate flood risk to Stanthorpe Close Estate as well as commercial properties along Streatham High Road.
- Contributing towards increasing biodiversity within LBL.
- Potential to provider broader public amenity benefits by involving the residents in the maintenance of the raingardens. Community activities could be developed around those schemes to enable residents to engage with the project.

Approximate Costs	£101k-£250k

CDA Specific Option STR_02 Stanthorpe Close Estate Raingardens

Figure 54 Stanthorpe Close Estate (opportunity for raingardens and tree pits)

Figure 55 Proposed flood storage area and raingarden conversion within the Stanthorpe Close Estate

Figure 56 Example sunken raingardens providing flood storage in urban environments (Source: SusDrain[29])

CDA Specific Option	STR_04 and STR_05 St Anselms Court Estate Swales
Address	St Anselms Court Estate, SW16
CDA	Streatham
Stakeholders and Partners	LBL Housing and Estates Team, LBL Highways Team, Thames Water

Option Description

Modelling for this area shows that surface water runoff arises from surcharging sewers underneath Valley Road and Valleyfield Road in the upper parts of the catchment. It then follows the topography along Madeira Road and Oakdale Road before reaching Streatham Station where residential and commercial properties are exposed to flood risk.

The St Anselms Court Estate is located between Madeira Road and Oakdale Road, along the main flow path (the "pathway") for the CDA. It benefits from an area of open space which has similar levels to Oakdale Road and is therefore well suited to provide flood attenuation for this flow path, to reduce the amount of water eventually reaching Streatham Station and mitigate flood risk to properties. Part of the estate is also at risk from flooding, and this scheme would therefore ensure water is conveyed away from the buildings.

It is proposed that runoff contained within Oakdale Road should be routed towards the estate's carpark using speed bumps. The diverted flow path would then follow topography towards the estate's central green space. Regrading of the green space to provide attenuation in a shallow basin structure, combined with shallow swales which would then convey the flow through the estate would provide an approximate flood storage of 270m^3 (based on an assumed attenuation and conveyance depth of 0.5m) before discharging the water back to the carriageway at a reduced rate compared to the present case.

In addition, to further reduce the pressure on the sewer network, roof drainage from the estate should be disconnected from the sewer and down pipes routed through raingardens to be built at the foot of estate buildings. Discharge from those raingardens should be at greenfield rate and routed through the swale.

It is recommended that a feasibility study is undertaken to determine the viability of the scheme by assessing the total storage volumes available and required to reduce flood risk to the estate, identifying constraints such as utilities and assessing the cost: benefits of undertaking such a scheme.

Potential Benefits

- Potential to mitigate flood risk to St Anselms Court Estate as well as properties closer to Streatham Station.
- Contributing towards increasing biodiversity within LBL.
- Potential to provider broader public amenity benefits by creating communal garden spaces around the swales and raingardens. Community activities could be developed around those schemes to enable residents to engage with the project.

Approximate Costs	£101k - £250k

CDA Specific Option STR_04 and STR_05 St Anselms Court Estate Swales

Figure 57 St Anselms Court Estate (opportunity for raingardens and tree pits)

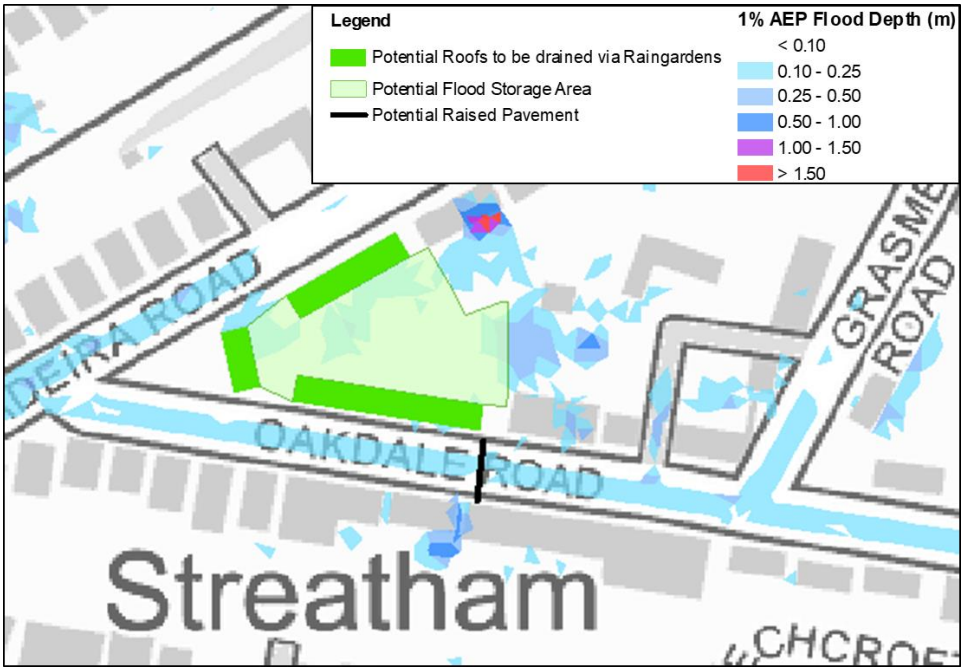


Figure 58 Proposed area to route and store water from Oakdale Road in the St Anselms Court Estate

CDA Specific Option	STV_01, STV_02, STV_03 The Rookery Flood Alleviation Scheme
Address	The Rookery, SW16
CDA	Streatham Vale
Stakeholders and Partners	LBL Parks Team, Thames Water, LBC

Option Description

The Rookery is located at the most upstream point in the Streatham Vale CDA. Modelling shows that surface water runoff arises from the park and the nature reserve located above the Rookery Gardens, before flowing through the gardens towards an existing drain (understood to be a Thames Water asset) which is then culverted underneath Covington Way. It is estimated that 0.63 m^3/s surface water discharges from the park towards the River Graveney in the 1% AEP event. This represents approximately 23% of the total flow following the River Graveney' s course in Norbury and putting residential properties at risk of flooding in Streatham Vale.

Intercepting runoff within the Rookery therefore provides the opportunity to mitigate flood risk at source, benefitting both residential and commercial properties across the catchment.

The proposed scheme includes a three-pronged approach:

- A swale following the footpath located south of the Rookery tennis court, routing and attenuating runoff from the nature reserve towards the open space alongside it. This swale could provide up to 515m^3 of flood storage (assuming a depth of 1m) and would discharge into the detention basin described below.
- Re-grading the parcel of land between the footpath and the Rookery Orchard into tiers, recreating the original terraces of the area. The lowest terrace should be designed as a detention basin which could provide up to 1,500m^3 flood storage (assuming a depth of 1m). The basin would discharge into the existing drain located south-west of the tennis court.
- Online detention ponds along the drain upstream of it being culverted under Covington Way to increase its storage capacity.

Regular maintenance of the Thames Water drains and infrastructure associated with it is also essential in this area to prevent blockages which could lead to unregulated surface water runoff.

Engagement with the LBC and Thames Water should be undertaken as the runoff emanating from the park also impacts properties in Norbury, which is at the border between LBL and LBC.

It is recommended that a feasibility study is undertaken to determine on-site suitability for the potential scheme, storage volumes, opportunities for environmental enhancements and to assess the cost: benefits of undertaking such a project.

Potential Benefits

- Potential to mitigate flood risk to commercial and residential properties in Norbury and Streatham Vale.
- Contributing towards increasing biodiversity within LBL.

CDA Specific Option	STV_01, STV_02, STV_03 The Rookery Flood Alleviation Scheme

- Reinstatement of the Rookery.
- Potential to provider broader public amenity benefits by creating communal garden spaces around the swales and online detention pools. Community activities could be developed around those schemes to enable residents to engage with the project.
- Improving public understanding of flood mitigation by showcasing the different types of SuDS used in this area using demonstration panels. This could help residents in engaging with the project.

Approximate Costs	> £251k (total cost)

Figure 59 The Rookery, Gardens

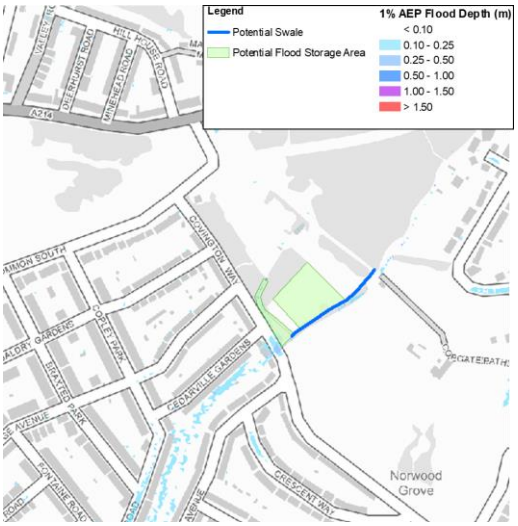


Figure 60 Areas available for routing and storage of surface water around the Rookery

Figure 61 Example of terraced flood storage area (Source: SusDrain[29])

CDA Specific Option	WDL_03 Meadow Park Flood Detention
Address	Meadow Park, SE19
CDA	West Dulwich
Stakeholders and Partners	LBS, Thames Water

Option Description

Modelling shows that surface water runoff originating in Dulwich (LBS) and the Gipsy Hill area (LBL) flows north towards West Dulwich and Herne Hill. Meadow Park (LBS) is located at the confluence of these flow paths and provides an opportunity to attenuate surface water runoff to mitigate flood risk to properties downstream in West Dulwich and Herne Hill.

Attenuation should be provided in Meadow Park using detention basin, or retention bunds. Below-ground storage could also be considered to increase capacity. It is estimated up to 1,500m^3 of storage could be provided within the park, assuming an average storage depth of 0.5m. Discharge to the sewer under Gipsy Hill from the storage feature should be controlled to greenfield rate.

To reduce pressure on the sewer network, it is also proposed to cap gullies along Gipsy Hill and route surface water runoff within the carriageway towards Meadow Park.

This scheme will require engagement with the LBS as the park is located within the LBS boundary but would provide flood mitigation to properties in LBL.

It is recommended that a feasibility study is undertaken to determine on-site suitability for the potential scheme, storage volumes, opportunities for environmental enhancements and to assess the cost: benefits of undertaking such a project.

Potential Benefits

- Potential to mitigate flood risk to commercial and residential properties in West Dulwich and Herne Hill.

Approximate Costs	£101k - £250k

CDA Specific Option WDL_03 Meadow Park Flood Detention

Figure 62 Meadow Park, London Borough of Southwark

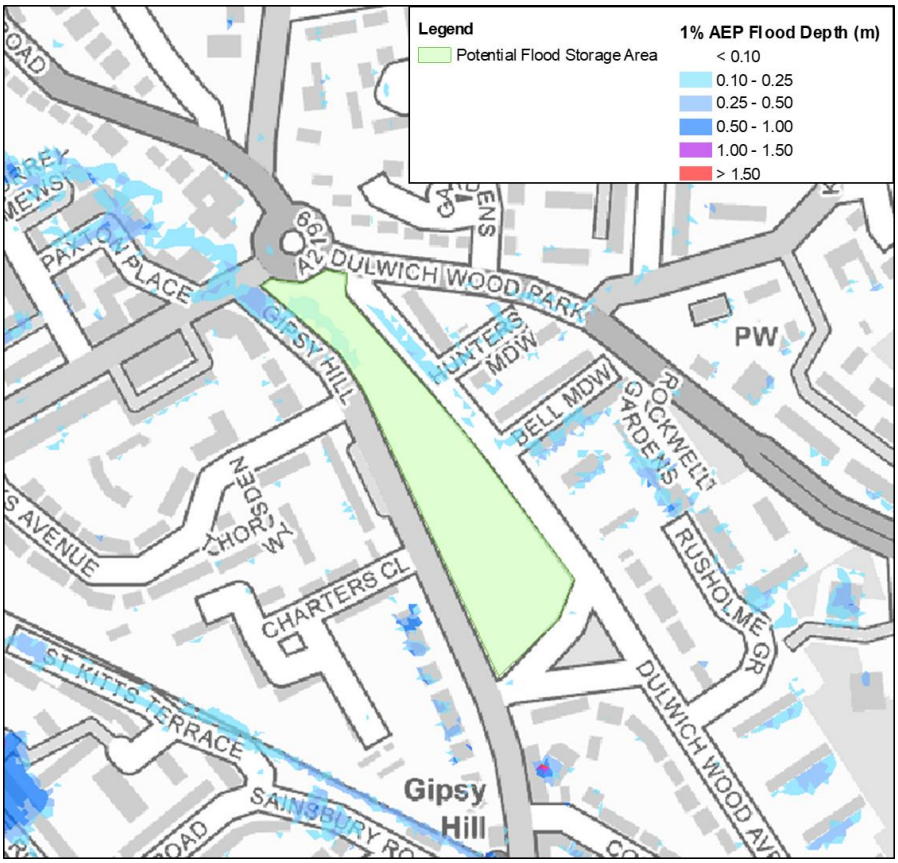


Figure 63 Area available for flood storage within Meadow Park

CDA Specific Option	WNR_01 Norwood Park Flood Alleviation Scheme
Address	Norwood Park, SE27
CDA	West Norwood
Stakeholders and Partners	LBL Parks Team, LBC, Thames Water

Option Description

The River Effra originated in West Norwood and flowed through the LBL and LBS before discharging in the River Thames. Surface water runoff from surcharging sewers in the upper parts of the West Norwood CDA follows the course of the river, causing numerous properties to flood across the entirety of LBL. In the Norwood Park area, properties are at risk of flooding due to both runoff following the flow path described above, but also runoff from the park itself.

Norwood Park presents an opportunity to intercept and attenuate surface water runoff in the upper parts of the catchment (flowing south to north), providing flood mitigation to properties in the immediate vicinity of the park, but also further downstream in the catchment (including within other CDAs).

Several solutions should be considered in this area to mitigate flood risk:

- Flood storage within the land south of the sports court by using bunds along the southern edge of the sports court to contain water within the park and reduce excess runoff impacting properties north of the park. It is estimated that up to 5,000m^3 of flood storage could be provided in this way (assuming a depth of 0.5m).
- Increase the capacity of the existing french drains located along the footpath on the northern edge of Norwood Park to reduce excess runoff from the footpath impacting properties north of the park.
- Provide property level protections along the northern edge of Norwood Park to prevent excess runoff from the park from impacting those.

Norwood Park is located on the boundary between LBL and LBC and as such the LBL should engage with their counterparts in LBC to develop this scheme.

It is recommended that a feasibility study is undertaken to determine on-site suitability for the potential scheme, storage volumes, opportunities for environmental enhancements and to assess the cost: benefits of undertaking such a project.

Potential Benefits

- Potential to mitigate flood risk to properties across the West Norwood CDA as well as further downstream.

Approximate Costs	£101k - £250k

CDA Specific Option WNR_01 Norwood Park Flood Alleviation Scheme

Figure 64 Norwood Park

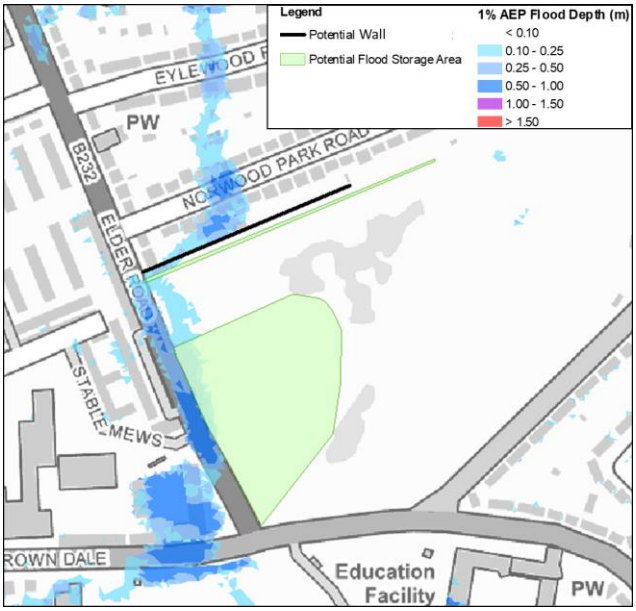


Figure 65 Indicative flood storage areas within Norwood Park

Figure 66 Example of shallow detention basin providing flood storage (Source: SusDrain[29])

CDA Specific Option	WNR_02 Astley House Raingardens
Address	Astley House, Gipsy Road, SE27
CDA	West Norwood
Stakeholders and Partners	LBL Housing and Estates Team, Thames Water

Option Description

The River Effra originated in West Norwood and flowed through the LBL and LBS before discharging in the River Thames. Surface water runoff from surcharging sewers in the upper parts of the West Norwood CDA follows the course of the river, causing numerous properties to flood across the entirety of LBL.

Astley House is located along this surface water flow path which crosses the open space in front of the estate. It is well suited to provide flood attenuation to reduce the amount of water eventually reaching the Dunbar street area and reduce pressure on the sewer. Part of the estate is also at risk from flooding, and this scheme would therefore ensure water is conveyed away from the buildings.

It is proposed that a shallow detention basin should be provided in the open space area, which could provide up to 225m^3 of flood storage assuming a depth of 0.5m. To reduce the pressure on the sewer network, roof drainage from the estate should be disconnected from the sewer and down pipes routed through raingardens to be built at the front of the building, along Gipsy Road. Discharge from those raingardens back to the sewer should be at greenfield rate.

It is recommended that a feasibility study is undertaken to determine on-site suitability for the potential scheme, storage volumes, opportunities for environmental enhancements and to assess the cost: benefits of undertaking such a project.

Potential Benefits

- Potential to mitigate flood risk to properties in the immediate vicinity of Astley House as well as around Dunbar Street.

Approximate Costs	£101k - £250k

Figure 67 Astley House aerial view (opportunity for a detention basin) and from Gipsy Hill (opportunity for raingardens)

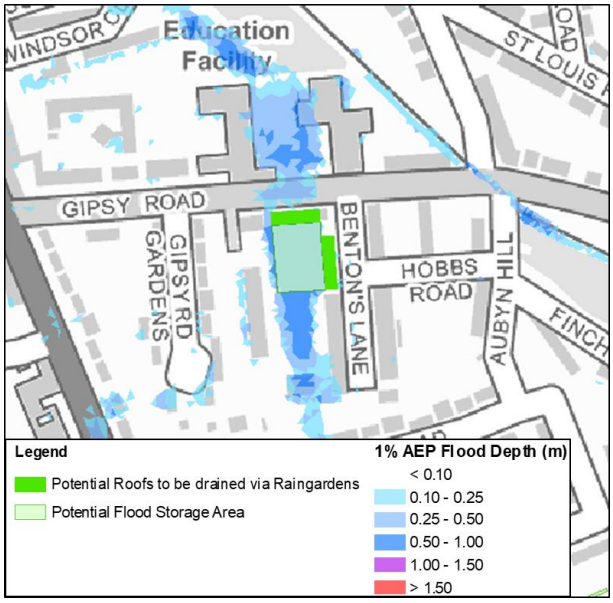


Figure 68 Indicative flood storage and roof disconnection areas around Astley House

Figure 69 Example roof disconnections draining into raingardens at the foot of the estate (Source: SusDrain[29])

5. Phase 4: Implementation & Review

5.1 Action Plan

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 LBL. An Action Plan was developed in collaboration with LBL following review of the previous phases of the SWMP and after engaging with other stakeholders internal to LBL. Several types of actions are identified as presented in Table 12.

Table 12 Types of Actions with the LBL Action Plan

Definition	Description
Policy Action	Spatial planning or development control actions
Communication/Partnership	Actions to communicate risk internally or externally to the wider LLFA and create and/or improve flood risk related partnerships.
Financial/Resourcing	Action to secure funding internally and/or externally to support works or additional resources to deliver actions.
Investigation/Feasibility/Design	Further investigation/feasibility study/design of mitigation.
Flood Mitigation Action	Maintenance or capital works undertaken to mitigate flood risk.

The Action Plan is presented in Table 13 and outlines a simple and useful set of actions relating to management of surface water flooding in the future.

The Action Plan should remain a live document, maintained and regularly updated by LBL as actions are progressed and investigated. Options and actions identified in this updated Lambeth SWMP may evolve or be discarded following detailed investigation. Equally, additional options and actions may arise which should be added to the Action Plan.

Table 13 Actions from the London Borough of Lambeth SWMP

Action ID	Type	Description	Ownership	Timeframe	Options Reference
01	Communication/ Partnership	Actively engage with members of the public regarding local flood risk management through presentation of existing and/or proposed schemes.	LBL	0-1 year	
02	Communication/ Partnership	Implement a standardised Flood Incident Log to record and investigate future flooding incidents within the London Borough of Lambeth.	LBL	0-1 year	
03	Communication/ Partnership	Work with TW to identify areas where sewer flooding impacts surface water flooding, making use of the SWMP findings and hydraulic modelling as the basis for discussion.	LBL/TW	1-5 years	
04	Communication/ Partnership	Work with the Environment Agency to incorporate any findings from the SWMP into other fluvial / pluvial modelling projects. This includes schemes such as Norbury Park.	LBL/EA	1.-5 years	
05	Communication/ Partnership	Share SWMP findings and hydraulic modelling outputs with the Environment Agency so that the agency's "Long-Term Flood Risk Information" mapping can be updated with the latest modelling.	LBL/EA	0-1 year	
06	Investigation/Feasibility/Design	Validate SWMP model outputs through engagement with the public and confirming outputs and drainage capacity assumptions with key stakeholders including TW, Network Rail and TfL.	LBL/TW/TfL/ Network Rail	1-5 years	
07	Communication/ Partnership	Share the SWMP findings and associated Highways Green Infrastructure Potential Map with other disciplines within the LBL to encourage increased collaboration between the disciplines and incorporation of SuDS within any suitable planned LBL works.	LBL	0-1 year	LBL_04
08	Investigation/Feasibility/Design	Develop SuDS information sheets for standard SuDS which can be issued to disciplines within LBL to facilitate engagement and initial assessments as to the feasibility of incorporating SuDS in other LBL led projects.	LBL	0-1 year	

09	Policy Action	Select the SWMP's key findings to incorporate in the LBL's Climate Adaptation Strategy.	LBL	1-5 years	
10	Flood Mitigation Action	Consider opportunities for ongoing improvements to the maintenance of the drainage network.	LBL	1-5 years	LBL_09
11	Policy Action	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'.	LBL	1-5 years	LBL_01
12	Policy Action	Ensure Development Control Policy incorporates surface water flood risk conditions and the latest available surface water flooding information including runoff rates, SuDS, driveway repaving etc.	LBL	1-5 years	
13	Flood Mitigation Action	Consider opportunities to promote rainwater harvesting in both new and existing development throughout the London Borough of Lambeth.	LBL	1-5 years	LBL_06
14	Flood Mitigation Action	Consider opportunities to promote use of water butts in both new and existing development throughout the London Borough of Lambeth.	LBL	1-5 years	LBL_07
15	Flood Mitigation Action	Consider opportunities to promote awareness of property level thresholds throughout the London Borough of Lambeth, particularly in areas of higher flood risk.	LBL	1-5 years	LBL_05
16	Communication/ Partnership	Consider and implement options for raising community awareness including letter drop, public meeting and/or provision of informative signs.	LBL	1-5 years	LBL_08
17	Flood Mitigation Action	Seek to incorporate SuDS within traffic calming measures as and when those are developed.	LBL	1-5 years	LBL_02
18	Flood Mitigation Action	Seek to attenuate surface water runoff emanating from LBL managed estates to greenfield runoff rates and combine this with planned estates improvement works.	LBL	1-5 years	LBL_03
19	Flood Mitigation Action	Undertake a feasibility to determine the viability of the potential flood storage and permeable surface sites by Bowland Road Estate.	LBL	1-5 years	CLP_01

20	Flood Mitigation Action	Undertake a feasibility to determine the viability of the potential flood storage and routing of surface water runoff in the Cato Road area.	LBL	1-5 years	CLP_03/CLP_05
21	Flood Mitigation Action	Engage with the LBL Highways Team to confirm the changes expected to road layout in the Railton Road area and assess the potential to extend this to a larger part of the CDA. A feasibility study should then be undertaken to determine the viability of the potential flood storage along this road.	LBL	1-5 years	RAR_02
22	Flood Mitigation Action	Undertake a feasibility to determine the viability of the potential flood storage and roof disconnection in the Solon Estate.	LBL	1-5 years	SLB_01
23	Flood Mitigation Action	Engage with the LBL Parks Team to confirm the space available for a flood storage scheme around Larkhall Park. A feasibility study should then be undertaken to assess the viability of the potential flood storage on the edge of the park.	LBL	1-5 years	SLB_07
24	Flood Mitigation Action	Undertake a feasibility to determine the viability of the potential flood storage and permeable paving around Blore Close and Bilton House.	LBL	1-5 years	SLB_10
25	Flood Mitigation Action	Engage with the LBL Parks Team to ensure flood mitigation can be a driver for the development of the Thessaly Road open space. A feasibility study should be undertaken to determine the viability of the potential flood storage in this park.	LBL	1-5 years	SLB_12
26	Flood Mitigation Action	Undertake a feasibility to determine the viability of the potential flood storage within the Stanthorpe Close Estate courtyard.	LBL	1-5 years	STR_02
27	Flood Mitigation Action	Undertake a feasibility to determine the viability of the potential flood storage within the St Anselms Court Estate.	LBL	1-5 years	STR_04/STR_05
28	Flood Mitigation Action	Engage with the LBC as the runoff emanating from the Rookery also impacts properties in Norbury, which is at the border between LBL and LBC. A feasibility study should be undertaken to determine on-site suitability the Rookery Flood Alleviation Scheme.	LBL	1-5 years	STV_01/STV_02/STV_03

29	Flood Mitigation Action	Engage with the LBS as part of the Meadow Park potential flood storage scheme. A feasibility study should be undertaken to determine on-site suitability for the potential scheme.	LBL	1-5 years	WDL_03
30	Flood Mitigation Action	Engage with LBC to further the assessment of providing storage within Norwood Park as the park is on the boundary between LBL and LBC.A feasibility study should be undertaken to determine the suitability of the proposed scheme.	LBL	1-5 years	WNR_01
31	Flood Mitigation Action	Undertake a feasibility to determine the viability of the potential flood storage and roof disconnections around Astley House.	LBL	1-5 years	WNR_03
32	Communication/ Partnership	Develop, update and maintain the draft Action Plan to meet the London Borough of Lambeth's local flood risk management priorities	LBL	0-1 year	
33	Financial/Resourcing	Identify local flood risk management funding opportunities through internal, external, existing and future funding initiatives and mechanisms.	LBL	0-1 year	

5.2 Implement and Review Action Plan

5.2.1 Review Timeframe and Responsibilities

The Action Plan identifies the relevant leads for each action. It also identifies the Partners and Stakeholders who should be consulted and engaged with as the actions are investigated and addressed.

Following completion of an action, the lead should update the Action Plan to reflect findings, issues and the action's outcome (further actions or closed off). This will support LBL in having the adequate oversight over surface water management progress within the Borough.

It is recommended that LBL organise quarterly reviews of this Action Plan along with key named Partners and Stakeholders. This will ensure that surface water management opportunities are not missed in the future.

5.2.2 Ongoing Monitoring

The partnership arrangements established as part of the SWMP process (e.g. LBS, LBW and LBC, TW and the Environment Agency) should continue beyond the completion of the updated Lambeth SWMP in order to discuss the implementation of the proposed actions, review opportunities for operational efficiencies and review any legislative changes.

As shown by the CDA delineation exercise, catchments do not follow borough boundaries. As such ongoing collaboration with the neighbouring boroughs of LBS, LBW and LBC will be essential to improve on current understanding of flood risk and share best practice procedures.

The SWMP Action Plan should be reviewed and updated annually as a minimum, but there may be circumstances which might trigger a review and/or an update of the Action Plan in the interim. Example triggers include:

- Occurrence of a surface water flood event;
- Additional data or modelling becoming available which may alter the understanding of surface water flood risk;
- Outcome of investment decisions by Partners different to the preferred option, which may require a revision of the Action Plan; and
- Additional (major) development or other changes in the catchment which may affect the surface water flood risk.

5.2.3 Updating SWMP Reports and Figures

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[1]. 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.

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 re-writing and replacing relevant chapter(s) and appendices;
- Amend and replace relevant SWMP maps; and
- Reissue to departments within the LBL and other stakeholders.

6. References

1. AECOM, CDA Delineation Methodology – Technical Note, April 2021
2. AECOM, Lambeth Hydraulic Modelling Model Build Report, April 2021
3. CIRIA, The SuDS Manual (C753), November 2015.
4. DCLG, Planning Practice Guidance: Flood Risk and Coastal Change, 2014. Available at: https://www.gov.uk/guidance/flood-risk-and-coastal-change
5. DCLG, National Planning Policy Framework, 2019. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2
6. DEFRA, The Government's Response to Sir Michael Pitt's Review of the summer 2007 Floods Progress Report, December 2009.
7. DEFRA, Surface Water Management Plan Technical Guidance, March 2010.
8. DEFRA, Surface Water Management – An Action Plan, July 2018
9. DEFRA and Environment Agency Flood and Coastal R&D Programme, Preliminary rainfall runoff management for developments, R&D Technical Report, W5-074/A/TR/1, Revision D, 2005
10. Environment Agency, Thames Catchment Flood Management Plan, December 2009
11. Environment Agency, Thames River Basin District River Basin Management Plan, December 2015
12. Environment Agency, Long-Term Flood Risk Mapping. Available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk . Accessed April 2020
13. Environment Agency, Flood risk assessments: climate change allowances, 2020. Available at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances
14. Greater London Authority, London Regional Flood Risk Appraisal, September 2018
15. Greater London Authority, Publication London Plan, December 2020
16. London Borough of Lambeth, Drain London - London Borough of Lambeth Preliminary Flood Risk Assessment, June 2011
17. London Borough of Lambeth, Surface Water Management Plan – Drain London - Lambeth, September 2011
18. London Borough of Lambeth, Strategic Flood Risk Assessment, March 2013
19. Lambeth Borough Council, Lambeth Local Plan, 2015. Available at: https://www.lambeth.gov.uk/sites/default/files/pl-lambeth-local-plan-2015-web.pdf
20. London Borough of Lambeth, Lambeth Local Flood Risk Management Strategy 2014-2020, October 2018
21. London Borough of Lambeth, Lambeth Local Development Scheme, October 2019
22. London Borough of Lambeth, Highway Green Infrastructure Potential Map GIS Tool, 2021
23. Met Office, UK Climate Projections, 2019. Available at: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index
24. Sir Michael Pitt, Learning Lessons from the 2007 floods, June 2008
25. SusDrain, SusDrain Photostream. Available at: https://flic.kr/ps/38jzth. Accessed April 2021
26. SusDrain, SuDS Management Train. Available at: https://www.susdrain.org/delivering-suds/using-suds/suds-principles/management-train.html . Accessed April 2021
27. Thames Water, Creating Resilient Wastewater Catchments. Available at: https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management. Accessed April 2021
28. UK Centre for Ecology and Hydrology, Flood Estimation Handbook Web-service. Accessible on: https://fehweb.ceh.ac.uk/ . Accessed January 2018
29. UK Government, Flood and Water Management Act, 2010. Available at: https://www.legislation.gov.uk/ukpga/2010/29/contents . Accessed January 2021

Appendix A CDA Delineation Methodology

Appendix B Lambeth Hydraulic Modelling Model Build Report

Appendix C Maps

The following maps have been produced to display the updated Lambeth SWMP Model baseline results for each return period according to flood depth, flow velocity and hazard rating.

Figure Number	Figure Title	Return Period
AMBETH_ICM_1%AEP_SD150_D	Modelled Surface Water Flood Depth: 50% AEP	1 in 2 Year (50% AEP)
LAMBETH_ICM_1%AEP_SD150_H	Modelled Surface Water Flood Velocity: 50% AEP	
LAMBETH_ICM_1%AEP_SD150_V	Modelled Surface Water Flood Hazard: 50% AEP	
LAMBETH_ICM_5%AEP_SD150_D	Modelled Surface Water Flood Depth: 5% AEP	1 in 20 Year (5% AEP)
LAMBETH_ICM_5%AEP_SD150_H	Modelled Surface Water Flood Velocity: 5% AEP	
LAMBETH_ICM_5%AEP_SD150_V	Modelled Surface Water Flood Hazard: 5% AEP	
LAMBETH_ICM_3.33%AEP_SD150_D	Modelled Surface Water Flood Depth: 3.33% AEP	1 in 30 Year (3.33% AEP)
LAMBETH_ICM_3.33%AEP_SD150_H	Modelled Surface Water Flood Velocity: 3.33% AEP	
LAMBETH_ICM_3.33%AEP_SD150_V	Modelled Surface Water Flood Hazard: 3.33% AEP	
LAMBETH_ICM_3.33%AEP+CC_SD150_D	Modelled Surface Water Flood Depth: 3.33% AEP+CC	1 in 30 Year + 40% CC (3.33% AEP)
LAMBETH_ICM_3.33%AEP+CC_SD150_H	Modelled Surface Water Flood Velocity: 3.33% AEP+CC	
LAMBETH_ICM_3.33%AEP+CC_SD150_V	Modelled Surface Water Flood Hazard: 3.33% AEP+CC	
LAMBETH_ICM_1.33%AEP_SD150_D	Modelled Surface Water Flood Depth: 1.33% AEP	1 in 75 Year (1.33% AEP)
LAMBETH_ICM_1.33%AEP_SD150_H	Modelled Surface Water Flood Velocity: 1.33% AEP	
LAMBETH_ICM_1.33%AEP_SD150_V	Modelled Surface Water Flood Hazard: 1.33% AEP	
LAMBETH_ICM_1%AEP_SD150_D	Modelled Surface Water Flood Depth: 1% AEP	1 in 100 Year (1% AEP)
LAMBETH_ICM_1%AEP_SD150_H	Modelled Surface Water Flood Velocity: 1% AEP	
LAMBETH_ICM_1%AEP_SD150_V	Modelled Surface Water Flood Hazard: 1% AEP	
LAMBETH_ICM_1%AEP+CC_SD150_D	Modelled Surface Water Flood Depth: 1% AEP+CC	1 in 100 Year (1% AEP) +40% CC
LAMBETH_ICM_1%AEP+CC_SD150_H	Modelled Surface Water Flood Velocity: 1% AEP+CC	
LAMBETH_ICM_1%AEP+CC_SD150_V	Modelled Surface Water Flood Hazard: 1% AEP+CC	
LAMBETH_ICM_0.5%AEP_SD150_D	Modelled Surface Water Flood Depth: 0.5% AEP	1 in 200 Year (1% AEP)
LAMBETH_ICM_0.5%AEP_SD150_H	Modelled Surface Water Flood Velocity: 0.5% AEP	
LAMBETH_ICM_0.5%AEP_SD150_V	Modelled Surface Water Flood Hazard: 0.5% AEP	
LAMBETH_ICM_0.1%AEP_SD150_D	Modelled Surface Water Flood Depth: 0.1% AEP	1 in 1000 Year (0.1% AEP)
LAMBETH_ICM_0.1%AEP_SD150_H	Modelled Surface Water Flood Velocity: 0.1% AEP	
LAMBETH_ICM_0.1%AEP_SD150_V	Modelled Surface Water Flood Hazard: 0.1% AEP	

Appendix D Damage Assessment Details

D.1 Methodology

D.2 Damage Assessment for each CDA

D.3 Damage Assessment for each LBL ward

Appendix E Options Assessment Details

E.1 Long List of Options

E.2 Long List of Options Locations

E.3 Highways Green Infrastructure Potential Map

Refer to the *Lambeth Highways Green Infrastructure Potential Map* folder for the Highways Green Infrastructure Potential Map in PDF format as well as a list of all highways within the London Borough of Lambeth, according to their position in the catchment and suitability for SuDS, in excel format.

aecom.com