Level 1 Strategic Flood Risk Assessment

London Borough of Camden

Project number: 60701446

January 2024

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Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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002	08/11/2023	FINAL DRAFT	Y	Heather Wells	Project Manager
003	11/01/2024	FINAL	Y	Heather Wells	Project Manager

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Executive Summary

As the Local Planning Authority, the London Borough of Camden are responsible for the publication of a Strategic Flood Risk Assessment (SFRA) in accordance with the National Planning Policy Framework (NPPF). The SFRA provides a strategic overview of flood risk to enable effective risk-based strategic planning for the future and supports development of the Camden Local Plan.

The SFRA fulfils the expectation of the NPPF and associated Planning Practice Guidance (PPG). It is a source of information that can be used to inform planning and development within the Borough and presents information to be used for undertaking the Sequential Test. The SFRA is informed by multiple sources of information, including stakeholder data and anecdotal evidence, to build a comprehensive overview of all sources of flood risk.

Flooding from surface water and sewer sources pose the greatest risk to the London Borough of Camden. The risk is interconnected, due to the prevalence of the combined sewer system which serves the Borough. Historic flood events, such as that of 1975, 2002 and 2021, suggest high volumes of surface water are conveyed overland due to the extent of impermeable surfaces and lack of infiltration. Multiple reports of internal and external property flooding have been linked to surface water sources. The large volume of water conveyed over land enters the Thames Water Utilities Limited combined sewer system. Flood incidents have been linked to surcharge of the sewer network at several locations (i.e., where the entrance and exits of assets such as manholes and pipes are submerged) as a result of blockages and hydraulic overload.

Flooding within the London Borough of Camden has also been attributed to ‘lost’ rivers, such as the River Fleet, River Westbourne (previously known as the River Kilburn), and River Tyburn. These rivers were once conveyed over land but have been integrated into the sewer network in the 19th Century to facilitate urban development. Areas underlain by the ‘lost’ rivers are at increased risk of flooding, due to natural catchment topography and drainage, connectivity to the sewer and the permeable River Terrace Deposits which follow the channel.

Similarly, areas underlain by permeable geology may be more susceptible to flooding from groundwater sources due to the capacity for groundwater storage and conveyance. This includes areas north and south of the Borough. Historic records indicate groundwater flooding occurred in 2012-2013. It is possible that other incidents of groundwater flooding have occurred, yet there is limited recorded information to confirm this.

Within the London Borough of Camden, there is residual flood risk from artificial sources such as reservoirs, canals as a result of infrastructure failure. The residual risk from these sources is well managed. Large scale projects, such as the Ponds Project (2016), have improved the Standard of Protection offered by dam and reservoir structures in Hampstead Heath.

Section 36 of the Town and Country Planning Act 1990 and Section 3 of the NPPF sets out the requirements for preparing a Local Plan which each Local Planning Authority is expected to prepare and review at least once every five years. This SFRA provides evidence for Camden Council to consider as part of the Local Plan development, on the basis of key flood risks and opportunities for development within the Borough. It also provides guidance for site-specific Flood Risk Assessments to be undertaken by, or on behalf of, a developer. The SFRA feeds into Regulation 18 (evidence gathering and early stage consultation) where the evidence presented in the SFRA informs the development of new policies to help shape the future of the Borough in a sustainable manner, whilst fulfilling the expectations of the PPG.

Abbreviations and Glossary of Terms

Abbreviations

Acronym	Definition
AEP	Annual Exceedance Probability
DEFRA	Department for Environment, Food and Rural Affairs
GARDIT	General Aquifer Research Development and Investigation Team
FLIP	Flooding Local Improvement Projects
GIS	Geographical Information System
LiDAR	Light Detection and Ranging
NPPF	National Planning Policy Framework
OFWAT	The Water Services Regulation Authority
OS NGR	Ordnance Survey National Grid Reference
PPG	Planning Practice Guidance
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
WFD	Water Framework Directive

Glossary of Terms

Term	Description
Annual exceedance probability (AEP)	Annual exceedance probability of occurrence in any one year, expressed as a percentage. For example, a 1 in 200 annual exceedance probability event has a 0.5% AEP of occurring in any year.
Aquifer	A source of groundwater comprising water bearing rock, sand, or gravel capable of yielding significant quantities of water.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human action. For rainfall events, a 40% increase is applied for a 1% Annual Exceedance Probability Event in the upper allowance scenarios in 2070s. These climate change values are based upon guidance published by the Environment Agency in Section 4.5.
Local 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. The definition is defined by Drain London where Local Critical Drainage Areas are predominately upstream drainage catchments which contribute to flooding in the Local Flood Risk Zones.
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Exception Test	The exception test should be applied following the application of the Sequential Test. Conditions need to be met before the Exception Test can be satisfied.
Flood Defence	Infrastructure used to protect an area against floods which may include floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Resilience	Measures that minimise water ingress and promotes fast drying and easy cleaning, to prevent any permanent damage.
Flood Resistant	Measures to prevent flood water entering a building or damaging its fabric. This has the same meaning as flood proof.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress, and disruption).
Flood Risk Area	An area determined as having a significant risk of flooding is defined by the Environment Agency, for flood risk areas from Main Rivers and Sea, and the Lead Local Flood Authority for surface water food risk.
Flood Zone	Flood Zones show the probability of flooding, ignoring the presence of existing defences.
Freeboard	Height of flood defence crest level (or building level) above designed water level.
Functional Floodplain	Land where water has to flow or be stored in times of flood. As per the Planning Practice Guidance, this is defined as the 1 in 30 year event (3.3% Annual Exceedance Probability).
Lead Local Flood Authority	As defined by the Flood and Water Management Act 2010, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area, in this case the London Borough of Camden.
Local Flood Risk Zone	Discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area', but still affect houses, businesses, or infrastructure. A Local Flood Risk Zone is defined as the actual spatial extent of the predicted flooding in a single location.
Local Planning Authority	Body that is responsible for controlling planning and development through the planning system.
Main River	Watercourse defined on a 'Main River Map' designated by Department Education, Food and Rural Affairs (DEFRA). The Environment Agency has permissive powers to carry out flood defence works, maintenance, and operational activities for Main Rivers only.
Mitigation Measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.

Term	Description
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	Aims to steer vulnerable development to areas of lowest flood risk from all sources.
Source Protection Zone	Defined areas in which certain types of development are restricted to ensure that groundwater sources remain free from contaminants.
Sustainable Drainage Systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Topographic Survey	A survey of ground levels.
Watercourse	All rivers, streams, drainage ditches (i.e., ditches with outfalls and capacity to convey flow), drains, cuts, culverts, and dykes that carry water. The Lead Local Flood Authority manage Ordinary Watercourses which are not identified as a Main River.

1. Introduction

1.1 Background

1.1.1 The National Planning Policy Framework (NPPF)[1] and associated Planning Practice Guidance (PPG) for Flood Risk and Coastal Change[2] emphasise the active role of Local Planning Authorities in managing flood risk.

1.1.2 Local Planning Authorities such as Camden Council must ensure flood risk is understood and managed sustainably throughout all stages of the planning process. The London Borough of Camden is distinctive in its lack of Main Rivers and is located entirely within fluvial Flood Zone 1, which is defined as having a less than 0.1% Annual Exceedance Probability (AEP) of flooding from fluvial sources. However, the Borough is at risk of flooding from surface water, groundwater, sewers, and artificial flood sources, such as reservoirs and canals.

1.1.3 In accordance with the NPPF, strategic policies should seek to manage flood risk from all sources and be informed by a Strategic Flood Risk Assessment (SFRA). Strategic policies, such as those outlined within a Local Plan, should also consider advice from the Environment Agency and other relevant flood management authorities. **Figure 1** reproduced from the PPG illustrates how flood risk should be considered in the preparation of the Local Plan for the London Borough of Camden.

1.1.4 Information set out within the SFRA is to be used by groups such as developers, emergency services, neighbourhood planning bodies and Camden Council, for activities relating to local planning, strategy, and flood risk management.

1.1.5 This SFRA document replaces the earlier version of the SFRA, which was produced by URS on behalf of the Council in July 2014[3].

1.2 Aims and Objectives

1.2.1 This SFRA builds upon information outlined within the London Borough of Camden SFRA produced by URS on July 2014, hereafter referred to as 'SFRA (2014)'. It updates national and local legislation and captures the most recent information relating to flood risk within the London Borough of Camden.

1.2.2 The aims of the SFRA are to:

- Provide a strategic overview of flood risk within the London Borough of Camden, to enable effective risk-based strategic planning for the future. This includes but is not limited to the preparation of the Local Plan;
- Provide a source of information which can be used by Camden Council to inform knowledge of flooding and flood risk from all sources, throughout the Borough; and
- Introduce an approach for applying the Sequential Test for Camden Council, which can be applied to all future development within the Borough.

1.2.3 The objectives of the SFRA are to:

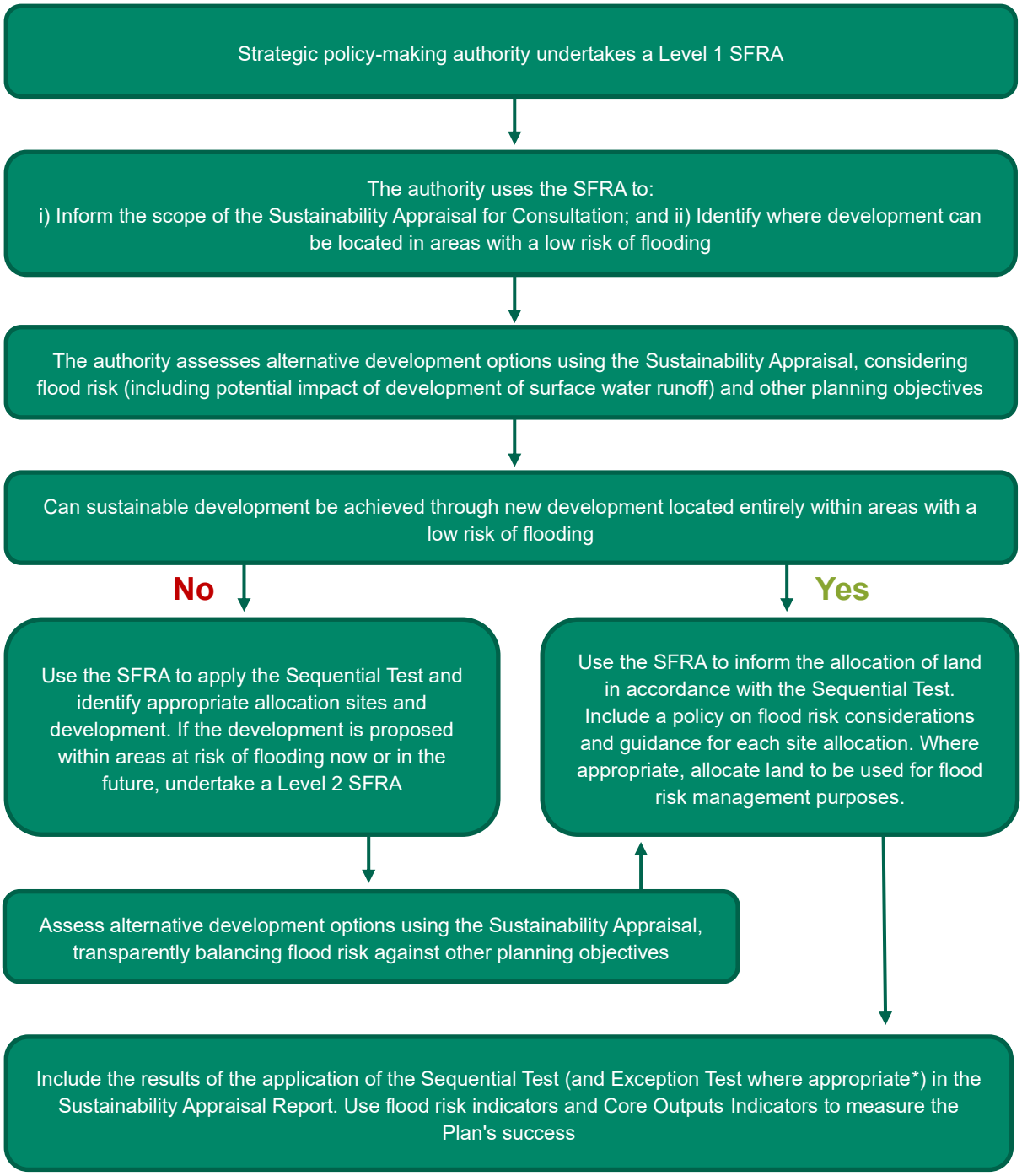
- Review national and local legislation, policy documentation and planning guidance that is relevant to managing flood risk within the London Borough of Camden,
- Review and capture up to date information from Risk Management Authorities, stakeholder groups and open datasets, to inform the evidence base,

[1] GOV.UK Department for Levelling Up, Housing and Communities, National Planning Policy Framework (2023). [Online]. Available: https://www.gov.uk/government/publications/national-planning-policy-framework--2 [Accessed: 02/05/2023]
[2] GOV.UK Ministry of Housing, Communities and Local Government & Department for Levelling Up, Housing and Communities, Guidance: Flood Risk and Coastal Change (2022). [Online]. Available: https://www.gov.uk/guidance/flood-risk-and-coastal-change [Accessed: 02/05/2023]
[3] Camden Council, London Borough of Camden Strategic Flood Risk Assessment (2014). [Online]. Available: https://www.camden.gov.uk/documents/20142/15822724/LB+Camden+Strategic+Flood+Risk+Assessment+2014.pdf/25379616-c452-b39b-9839-9f0c374cfa83 [Accessed: 26/04/2023]

- Use data sources to assess the risk of flooding from all sources, including fluvial, surface water, groundwater, sewer and artificial sources of flooding, such as reservoir and canal,
- Develop a methodology for applying the Sequential Test, referring to stakeholder data, open datasets, and anecdotal evidence, which accounts for flooding from all sources,
- Review and provide recommendations for the Local Flood Risk Zones,
- Provide tailored guidance for site-specific flood risk assessments, and
- Provide relevant information to Camden Council which can be used to inform development of local policies, and decision making about proposals for development.

1.3 Plan Making

1.3.1 Camden Council are preparing a Local Plan, expected to be adopted in 2026. The NPPF and PPG set out how Local Authorities should consider flood risk as part of the preparation of Local Plans. This is presented in **Figure 1** (overleaf).



** In the case of the London Borough of Camden, the Exception Test is not required, as the Borough is classified as Flood Zone 1 – no development will be located within Flood Zone 2 or 3, therefore the Exception Test is not applicable.*

Figure 1: Taking flood risk into account in the preparation of a Local Plan (PPG Flood Risk and Coastal Change)

1.4 Flood Risk Management Approach

1.4.1 The PPG Flood Risk and Coastal Change outlines the process to be used when an assessment shows flood risk is a consideration for a plan or development proposal[2]. The approach is designed to direct development away from areas at highest risk of flooding, whether existing or in the future. Should development be necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere. The following section outlines the process to be followed by Local Planning Authorities, such as Camden Council, in order to protect people and property from flooding.

Assess Flood Risk

1.4.2 The type and extent of flood risk within the Borough should first be understood. The assessment of flood risk should be undertaken throughout all stages of the process. The PPG stipulates:

- *"Strategic policy-making authorities should undertake a Strategic Flood Risk Assessment;*
- *Where appropriate, in areas at risk of flooding, developers undertake a site-specific flood risk assessment to accompany applications for planning permission (or prior approval for certain permitted development rights, or Technical Details Consent); and*
- *Assessments of flood risk identify sources of uncertainty and how these are accounted for in a mitigation strategy. Further information on how to do this can be found in flood risk assessment for planning applications."*

Avoid Flood Risk

1.4.3 Where an assessment indicates flood risk is a consideration for a plan or development proposal, the PPG instructs the following action to be undertaken by the Local Planning Authority:

- *"In plan-making, a sequential approach should be employed. This involves applying the 'Sequential Test' and, if needed, the 'Exception Test';*
- *In decision-making, where necessary, planning authorities also apply the Sequential Test and, if needed, the Exception Test, to ensure that flood risk is minimised and appropriately addressed;*
- *Where the Sequential and the Exception tests have been applied as necessary and not met, development should not be allowed;*
- *Substitute lower vulnerability uses for higher vulnerability uses; and*
- *Within sites, using site layout to locate the most vulnerable aspects of development in areas of lowest flood risk, unless there are overriding reasons to prefer a different location. In addition, measures to avoid flood risk vertically can then be taken, by locating the most vulnerable uses on upper storeys, and by raising finished floor and/or ground levels, where appropriate and that such techniques are suitably designed. Such measures should also account for residual flood risks from flood risk management infrastructure."*

1.4.4 As indicated above, development is allowed when the Sequential and Exception Tests (if applicable) have been met. Further detail of each test is presented within **Section 6** of this SFRA.

Control Flood Risk

1.4.5 Measures should be investigated, to control the risk of flooding affecting the site. The investigation can be undertaken by the Local Planning Authority and the developers involved. Early discussions with relevant Flood Risk Management Authorities should be prioritised and reference should be made to SFRA documentation and available programmes of Flood and Coastal Erosion Risk Management Schemes, to help identify opportunities.

1.4.6 In the case of the London Borough of Camden, the relevant Risk Management Authorities include Camden Council (who act as Local Planning Authority and Lead Local Flood Authority), Environment Agency, Thames Water Utilities Limited, Transport for London and the Greater London Authority.

Mitigate Flood Risk

1.4.7 The PPG states that flood resistance and resilience measures should be used to address any residual flood risk which remains following the implementation of avoidance and control measures. The flood resistance and resilience measures cannot be used to justify development in inappropriate locations.

1.4.8 Passive measures should be prioritised over active measures, as passive measures are more likely to be effective and reliable during a flood event. This is because passive measures do not require manual activation and typically do not require a high level of maintenance, whereas active measures require deployment.

1.4.9 Passive measures include but are not limited to resilient building materials, full length flood doors and automatic airbrick covers. Active measures include door guards, window guards and sandbags.

1.4.10 Passive and active measures typically target the threshold of a building, where flood waters could infiltrate the property. Common flood resistant materials include concrete and steel yet may also comprise masonry which has been produced with an impervious layer, such as water resistant render or asphalt. Cavity walls may be filled with water resistant insultation below the flood level.

Manage Residual Flood Risk

1.4.11 Further flood risk management measures to address any residual risk should be reviewed and implemented, as appropriate, after avoidance, control and mitigation measures have been utilised. As defined within the PPG, residual risk is present in two forms, including residual risk from flood risk management infrastructure and to a development once any site-specific flood mitigations are taken into account.

1.4.12 Considerations for safe access, egress routes and adequate flood warnings should be made, to ensure people are not exposed to hazardous flooding. This approach should be considered early in the design process. The Local Planning Authority should be able to demonstrate with satisfaction that the development will be safe for its lifetime, accounting for the vulnerability of its users.

1.4.13 If an impact cannot be wholly mitigated, developers are required to cover the full cost of any additional emergency services provision needed. It is recommended that this is confirmed during the planning process as opposed to post-occupation.

1.5 Strategic Flood Risk Assessment Structure

1.5.1 It is anticipated the SFRA will have a number of end users, with slightly different requirements. This section describes how to use and navigate the SFRA. The document builds upon the previous 2014 SFRA. Updates to planning and policy guidance have been accounted for within this SFRA, to represent the most recent legislation.

1.5.2 This SFRA report is set out as follows:

- Abbreviation and Glossary of Terms
- Section 1: Introduction
- Section 2: SFRA Methodology
- Section 3: Study Area
- Section 4: Policy Context
- Section 5: Flood Risk in the London Borough of Camden
- Section 6: Applying the Sequential Test
- Section 7: Site Specific Flood Risk Assessment Guidance
- Section 8: Recommendations
- Appendix A: Figures
- Appendix B: Data Register

- Appendix C: Climate Change Allowances
- Appendix D: Camden Geological, Hydrogeological and Hydrological Study – Effect of Basements on Groundwater Flow
- Appendix E: Site-Specific Flood Risk Assessment Checklist

2. Strategic Flood Risk Assessment Methodology

2.1 Overview

2.1.1 Under Section 14 of the NPPF, the risk of all sources of flooding must be considered as part of a SFRA. This includes flooding from rivers, land, groundwater, sewers, and artificial sources. The information in this Level 1 SFRA should be used by the Local Planning Authority to enable application of the NPPF Sequential Test.

2.1.2 As defined within the PPG, a SFRA is a "*study carried out by one or more Local Authorities or other Strategic Policy-Making Authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the cumulative impact that land use changes and development in the area will have on flood risk. It identifies opportunities to reduce the causes and impacts of flooding and gathers information on the land that is likely to be needed for flood risk management infrastructure*."

2.1.3 The methodology for the appraisal of flood risk from all sources is outlined below including a description of the datasets used to assess the risk of flooding from each source.

2.2 Sequence of Tasks

2.2.1 The key stages of the SFRA development are outlined in **Table 2-1**.

Table 2-1: Strategic Flood Risk Assessment Methodology – Key Stages

Key Stage	Relevant Activity
Scoping	The SFRA scope was defined and developed by Camden Council as the Local Planning Authority and Lead Local Flood Authority for the Borough.
Consultation and Engagement (Data Collection)	As outlined in **Table 2-2**, a range of stakeholders were engaged at the early stages of document development to obtain data and anecdotal evidence.
Production	The document draws upon the SFRA (2014), to build upon the known information. Where new information has been released and/or amendments have been made since publication of the previous SFRA (2014), this document has been updated to reflect the current understanding. Multiple data sources were reviewed to produce the SFRA, including national and local legislation, stakeholder datasets, open data sources and anecdotal evidence. Where gaps and omissions in data were identified, supplementary information has been utilised to inform the document. References to the data sources are contained throughout the SFRA. All sources of flooding have been considered for the SFRA, in accordance with the NPPF. The document contains maps, supporting text and user guidance. It considers current and future risk, associated with climate change. This has formed the rational for the Sequential Test, developed as part of the SFRA.
Recommendations	The document describes how the SFRA can be used. Policy options which can be considered for the Local Plan are outlined with this SFRA.
Implementation	The SFRA clearly outlines the following approach to: Sequential Test and Exception Test (**Section 6**), Site Specific Flood Risk Assessment (**Section 7.1**), and Flood Risk Management Approach (**Section 7.2**).
Ongoing Data and Geographical Information Systems (GIS) Management	The maps are available in GIS format. Where appliable, Figures will be amended to reflect updates. The data used to generate the GIS outputs is referenced within the Data Register (**Appendix B**).

2.3 Data Collection - Sources

2.3.1 Several datasets have been used to assess the risk of flooding from each source. The information was obtained from open data sources and directly from key stakeholders. The role of the stakeholders involved in the development of the SFRA is detailed within **Table 2-2**.

Table 2-2: Stakeholder Organisations and Roles

Stakeholder Organisation	Role with respect to the London Borough of Camden SFRA
Camden Council	As Local Planning Authority, Camden Council have a responsibility to consider flood risk in their strategic land use planning and the development of their Local Plan. The NPPF requires Local Planning Authorities to undertake a SFRA and to use their findings, and those of other studies, to inform strategic land use planning including the application of the Sequential Test which seeks to steer development towards areas of lowest flood risk prior to consideration of areas of greater risk. Camden Council is also required to consider flood risk when assessing applications for development. During the preparation of the SFRA, records held by the Council of flood incidents across the Borough were used to help inform the flood risk within Camden. The SFRA should be used by the Camden Council Emergency Planning team so that the findings where appropriate are incorporated into their understanding of flood risk and the preparation of their Multi-Agency Flood Plan.
Environment Agency	The Environment Agency provide technical advice to Local Planning Authorities and developers on how best to avoid, manage and reduce the adverse impacts of flooding. Part of this role involves advising on the preparation of spatial plans and sustainability appraisals as well as the evidence base documents underlying such documents, including SFRAs. The Environment Agency perform a technical review role of the SFRA. The Environment Agency undertakes systematic modelling and mapping of surface water flood risk in the study area. Open data sources are regularly updated by the Environment Agency. The Environment Agency also directly supply data for use within the SFRA.
City of London Corporation	The City of London Corporation owns and is the custodian of Hampstead Heath, including the Hampstead Heath and Highgate pond chains. City of London Corporation is responsible for ensuring the ponds are safe by reducing the risk of dam failure. City of London Corporation was consulted in order to confirm the maintenance and management of the Hampstead Heath Ponds.
Thames Water Utilities Limited	Thames Water Utilities Limited is responsible for surface water and foul drainage from development via adopted sewers and for maintaining public sewers into which much of the highway drainage connects. In relation to the SFRA, the main role that Thames Water Utilities Limited plays is providing data regarding historic sewer flooding, sewer network mapping and supplying information on the Counters Creek Catchment.
British Geological Society	The British Geological Society holds a number of datasets that will inform the SFRA, including superficial and bedrock geology and susceptible to groundwater flooding data.
Transport for London	Transport for London are responsible for the running and management of the London Overground, London Underground and sections of the London road network. Transport for London were consulted to provide details of any known historic and recent flood risks across their infrastructure routes in the London Borough of Camden, flooding investigations and flood schemes in Spring 2023.
The Canal and River Trust	The Canal and River Trust maintains over 2,000 miles of canals and rivers in the UK, including Regent's Canal which runs through the southern perimeter of the London Borough of Camden. The Canal and River Trust provided high level details of managing The Canal and River Trust owned assets and confirmed the absence of any overtopping events in the Borough.

2.4 Data Collection - Methodology

2.4.1 The methodology for the appraisal of flood risk from all sources is outlined in the section below. Flooding from the sea is not relevant to the London Borough of Camden and has therefore not been further considered in this SFRA. This section includes key sources of information, which are critical to assessing the potential risk of flooding within the London Borough of Camden. A full list of data which has been considered for the development of this SFRA is presented within the Data Register (**Appendix B**).

Fluvial

2.4.2 All Main Rivers historically located within the London Borough of Camden are now culverted and incorporated into the Thames Water Utilities Limited sewer network. This includes the River Fleet, River Westbourne (also known as the River Kilburn), and River Tyburn. The channel of each 'lost' river has been depicted within **Appendix A** (**Figure 11**), on the basis of surface water flow paths from the Risk of Flooding from Surface Water map and watercourses illustrated within a historic map (1805-1874). Online sources of information such as historic records, maps[4,5] and anecdotal evidence, have been used to review the likely flow conveyance. As such, outputs presented within **Appendix A** (**Figure 11**) are only indicative of likely flow conveyance and the alignment of the 'lost' river channels. As such, these outputs should not be used to inform design, however, can be used to highlight the need for a site-specific Flood Risk Assessment. **Section 5.4 - Historic Watercourses** details information relating to flood risk from the River Fleet, River Westbourne and River Tyburn 'lost' river.

2.4.3 The Historic Flood Map (**Appendix A**, **Figure 10**) and Flood Map for Planning datasets available from the Environment Agency have been reviewed to assess the potential risk of flooding from fluvial sources in the present day; this is presented in **Section 5.5**.

2.4.4 Fluvial models received from the Environment Agency have been reviewed for this SFRA, to present the defended 1% AEP (plus climate change allowance) scenarios for the River Lee, River Brent, and Silk Stream, in addition to the maximum predicted flood extents for the 2005 and 2100 epoch tidal breach scenario. The modelled outputs provided show the proximity of the flood extents to the London Borough of Camden and are presented in **Appendix A** (**Figure 29**) and (**Figure 30**).

2.4.5 Model outputs provided by the Environment Agency are named: River Lee 2D Modelled Study 2014, Brent Model Updated Study 2014, Silk Stream Modelling Study 2019, Thames Tidal Upriver Breach Modelling 2017, and the Thames Upriver Breach Model P5 and Tidal P7.

2.4.6 The functional floodplain has not been delineated, as the London Borough of Camden is entirely located within Flood Zone 1, outside the risk of flooding from Main River sources.

Surface Water

2.4.7 The Environment Agency Risk of Flooding from Surface Water mapping[6] is publicly available information which illustrates the level of surface water flood risk in England and Wales. It is a strategic tool that does not account for site-specific hydraulic conditions or flood mechanisms and cannot identify the susceptibility of individual properties to surface water flooding. The Risk of Flooding from Surface Water mapping is produced by the Environment Agency, using information provided by the relevant Lead Local Flood Authority, to assess and manage surface water flooding. Surface water flood risk is the responsibility of the Lead Local Flood Authority, who work in partnership with the Environment Agency, District Councils, and utility companies.

2.4.8 For the purposes of this SFRA, Risk of Flooding from Surface Water mapping has been used to understand where surface water flooding is likely to flow or pond within the London Borough of Camden. Anecdotal evidence of flooding provides information relating surface water flooding within the Borough. As defined by the Environment Agency, levels of surface water flood risk are classified as follows:

- High risk – an area with an annual chance of flooding greater than a 1 in 30 year event (3.33% AEP);
- Medium risk – an area with an annual chance of flooding between a 1 in 100 year (1% AEP) and 1 in 30 year event (3.33%); and
- Low risk – an area with an annual chance of flooding between a 1 in 1000 year (0.1% AEP) and 1 in 100 year event (1% AEP).

[4] Historic Map, 'London Before Houses' [Online]. Available: https://upload.wikimedia.org/wikipedia/commons/d/db/LondonBeforeHouses.jpg [Accessed:02/05/2023]
[5] inews, Story of London's lost River Fleet and how it became part of the sewer system after years of belonging to fishermen [Online]. Available: https://inews.co.uk/news/environment/london-river-fleet-sewer-system-fishermen-haunt-347211 [Accessed: 02/05/2023]
[6] Environment Agency, Risk of Flooding from Surface Water. [Online]. Available: https://www.gov.uk/check-long-term-flood-risk [Accessed: 02/05/2023]

2.4.9 The Risk of Flooding from Surface Water does not include a specific scenario to determine the impact of climate change on surface water flood risk. However, a range of three AEP events has been assessed, including a 3.33%, 1% and 0.1% AEP event. It is considered appropriate to use the 0.1% AEP event as a substitute dataset, to provide an indication of the implications of climate change.

2.4.10 Anecdotal records of surface water flooding can be used to validate findings of the Risk of Flooding from Surface Water and modelled outputs. Significant flood events affecting the London Borough of Camden, with known impacts from surface water flooding, include the events of 1975, 2002 and 2021. Information on these events has been obtained from Camden Council and online sources.

2.4.11 The risk of flooding from surface water is presented in **Section 5.2**.

Groundwater

2.4.12 **Table 2-3** details the datasets which were supplied by Camden Council and British Geological Society. The datasets relate to the underlying geology, presence of groundwater and risk of groundwater flooding.

Table 2-3: Groundwater Data Sources

Dataset Title	Source	Description	Figure
"Bedrock Geology"	Camden Council	Dataset showing the bedrock geology type underlying the London Borough of Camden	**Appendix A (Figure 12)**
"British Geological Society Geology 625k data – Superficial"	British Geological Society	Dataset showing the superficial geology type underlying areas of the London Borough of Camden	**Appendix A (Figure 13)**
"Susceptibility to Groundwater Flooding"	British Geological Society and Camden Council	Dataset showing the areas susceptible to groundwater flooding, on basis of geological and hydrogeological conditions. The potential for groundwater flooding at surface, of a property below ground level and where there is limited potential for flooding. Areas not considered to be prone to groundwater flooding are also highlighted.	**Appendix A (Figure 19)**
Aquifer Designation Map	Camden Council	Dataset to identify the different aquifers, consistent with the WFD. The designations reflect importance of groundwater as a resource and role in supporting surface water flows	**Appendix A (Figure 20)**

2.4.13 To assess the risk of groundwater flooding in the London Borough of Camden, the GIS outputs for British Geological Society bedrock and superficial geology types were reviewed against information pertaining to the underlying aquifer type, bedrock permeability and groundwater susceptibility. Data presented within the Aquifer Designation Map available via the MAGIC map service[7] was reviewed to confirm the aquifer type. The Aquifer Designations are defined by the Environment Agency as follows[8]:

- Principal Aquifer: provides significant quantities of drinking water and may also support rivers, lakes, and wetlands,
- Secondary A Aquifer: comprise permeable layers that can support local water suppliers and may form an important source of base flow to rivers,
- Secondary B Aquifer: mainly lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin cracks (called fissures), openings or eroded layers, and

[7] DEFRA, MAGIC Map [Online]. Available: https://magic.defra.gov.uk/magicmap.aspx [Accessed: 02/05/2023]
[8] Environment Agency, Guidance: Protect Groundwater and Prevent Groundwater Pollution. [Online]. Available: https://www.gov.uk/government/publications/protect-groundwater-and-prevent-groundwater-pollution/protect-groundwater-and-prevent-groundwater-pollution#:~:text=Principal%20and%20secondary%20aquifers%20provide,support%20rivers%2C%20lakes%20and%20wetlands. [Accessed: 24/07/2023]

- Secondary Undifferentiated Aquifers: aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These only have minor value.

2.4.14 Source Protection Zones have been reviewed as part of this SFRA, via the MAGIC Map service[7]. Source Protection Zones are defined around large and public potable groundwater abstraction sites. Although the presence of a Source Protection Zone is not primarily of consideration in relation to flood risk, it should be accounted for when assessing the environmental impact of a development such as pollution. The Source Protection Zone are defined as follows:

- Inner Zone – Source Protection Zone1: this zone is 50 day travel time of pollutant to source with a 50 m default minimum radius;
- Outer Zone – Source Protection Zone2: this zone is 400 day travel time of pollutant to source. This has a 250 m or 500 m minimum radius around the source depending on the amount of water taken; and
- Total Catchment – Source Protection Zone3: this is the area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken. This could extend some distance from the source point; and
- Zone of Special Interest – Source Protection Zone4: this zone is where local conditions require additional protection.

2.4.15 Considerations are made for the potential impact of basement developments on groundwater flood risk. Historical flooding provided by Camden Council has been reviewed to develop an understanding of basement flooding within the London Borough of Camden and how this may be affected by, or may affect, groundwater flooding.

2.4.16 The risk of flooding from groundwater sources is presented within **Section 5.3**.

Sewers

2.4.17 Sewer flooding is associated with the sewer and drainage network infrastructure. It may occur from exceeded capacity of the sewer system following a storm event, blockages by debris or sediment, and system surcharge due to high water levels in receiving watercourses.

2.4.18 For the purposes of the SFRA, Thames Water Utilities Limited have supplied DG5 Flood Register records for the Borough. Water utility companies, such as Thames Water Utilities Limited, are regulated by the Water Services Regulation Authority (OFWAT) and are required to maintain records of sewer flooding and its frequency, and to address risk through capital investment plans.

2.4.19 The DG5 data has not been provided at an individual property level, due to data protection requirements. The data comprises the number of properties within a 4 digit postcode area that have experienced flooding from sewer sources over the past 10 years. Please note, Thames Water Utilities Limited target these areas for maintenance and improvements, as such, the areas that have experienced flooding in the past may no longer be at the greatest risk of flooding. The DG5 records account for reports of internal and external flooding, associated with combined, foul, private and surface water sewer systems. It should also be noted that these flooding incidents have been reported to Thames Water Utilities Limited by homeowners. Incidents of sewer flooding that have not been reported will not be shown on the register Sewer mapping outputs have also been provided by Thames Water Utilities Limited, to indicate the general arrangement of sewer infrastructure within the London Borough of Camden. This includes gravity sewers, drains, pressure mains and lateral sewers, in addition to manholes.

2.4.20 The flood risk from sewer sources is presented within **Section 5.4**.

2.4.21 Historic mapping to produce **Appendix A** (**Figure 11**) was obtained for the period of 1805-1874 from Emapsite.

Artificial Sources: Reservoir, Canal, and Other Artificial Sources

2.4.22 The Environment Agency Risk of Flooding from Reservoirs mapping[9] identifies areas that could be flooded if a large reservoir were to fail and release the water it holds. The Reservoir Flood Maps show a 'wet day' and 'dry day' scenario which have both been reviewed for the purposes of this SFRA. This only accounts for the individual flood extents of large reservoirs in the event the structure were to fail and release water on a 'wet day' (when rivers had already overtopped their banks) or a 'dry day' (when river levels are normal), respectively. The Reservoir Maps for the 'wet day' and 'dry day' scenario area presented in **Appendix A** (**Figure 24** and **Figure 25**).

2.4.23 In accordance with the Reservoir Act 1975[10], a large reservoir is defined as a raised structure designed for collecting and storing water or a raised waterbody capable of holding more than 10,000 cubic metres of water above that level. There are three water bodies designated as 'large' within the London Borough of Camden, including: Hampstead Pond No. 1, Highgate Men's Bathing Pond and Highgate Model Boating Pond[11]. Maiden Lane Reservoir is located east of the London Borough of Camden, immediately beyond the boundary, within the Borough of Islington. It is a covered reservoir on Dartmouth Park Hill which was completed in summer 2022.

2.4.24 Although located outside of the London Borough of Camden boundary, the proximity of the Maiden Lane Reservoir could pose a flood risk to the Borough. Therefore, the reservoir has been considered as part of this SFRA.

2.4.25 **Table 2-4** provides a summary of water bodies with an area ≥1,500m^2 within the Borough. The area of the water bodies is an approximation generated from aerial imagery. Although a number of smaller ponds, pools and other water bodies are present within the London Borough of Camden, these have not been examined as part of the SFRA development due to size and the limited impact on local flood risk.

2.4.26 The risk from reservoir and canal sources is discussed in **Section 5.6**.

[9] GOV.UK, Guidance: Reservoir Flood Maps – When and How to Use Them [Online]. Available: https://www.gov.uk/guidance/reservoir-flood-maps-when-and-how-to-use-them [Accessed: 02/05/2023]
[10] GOV.UK, Reservoir Act 1975 [Online]. Available: https://www.legislation.gov.uk/ukpga/1975/23 [Accessed: 04/05/2023]
[11] City of London, Hampstead Heath Dams Project-Full Court Decision Part One of Two (2014). [Online]. Available: https://news.cityoflondon.gov.uk/hampstead-heath-dams-project-full-court-decision--part-one-of-two/ [Accessed: 10/07/2023]

Table 2-4: Artificial Flood Sources / Water Bodies

Area	Water body	Approximate Area (m^2)	Approximate (Ordnance Survey National Grid Reference) OS NGR	Regulated under the Reservoirs Act 1975
Hampstead Heath	Wood Pond	6,700	TQ 27143 87194	N
Hampstead Heath	Thousand Pound Pond	3,100	TQ 27263 87174	N
Hampstead Heath (Highgate Pond Chain)	Stock Pond	2,400	TQ 27539 87127	N
Hampstead Heath (Highgate Pond Chain)	Kenwood Ladies' Bathing Pond	6,000	TQ 27599 86952	N
Hampstead Heath (Highgate Pond Chain)	Bird Sanctuary Pond	4,800	TQ 27711 86820	N
Hampstead Heath (Highgate Pond Chain)	Model Boating Pond (also referred to as Highgate No. 3 Pond)	14,000	TQ 27786 86704	Y
Hampstead Heath (Highgate Pond Chain)	Highgate Men's Bathing Pond (also referred to as Highgate No. 2 Pond)	16,100	TQ 27873 86509	Y
Hampstead Heath (Highgate Pond Chain)	Highgate No. 1 Pond	11,100	TQ 27995 86408	N
Hampstead Heath	Leg of Mutton Pond	2,300	TQ 25642 86677	N
Hampstead Heath (Hampstead Pond Chain)	Vale of Health Pond	7,500	TQ 26621 86414	N
Hampstead Heath (Hampstead Pond Chain)	Viaduct Pond	2,500	TQ 26937 86478	N
Hampstead Heath (Hampstead Pond Chain)	Mixed Bathing Pond (No. 3)	5,800	TQ 27229 86174	N
Hampstead Heath (Hampstead Pond Chain)	Hampstead No. 2 Pond	9,700	TQ 27295 86049	N
Hampstead Heath (Hampstead Pond Chain)	Hampstead No. 1 Pond	15,000	TQ 27275 85885	Y
Waterlow Park	Waterlow Park Lakes	2,600 and 1,500	TQ 28695 87080	N
King's Cross / Camden Town	Regent's Canal	49,000	N/A	N

Historic Flooding

2.4.27 Information on historic flooding within the Borough has been obtained from the Flood Risk Management Strategy (2023), Surface Water Management Plan (2011) and the Section 19 Flood Investigation Report for the July 12th and 25th 2021 flood event. Information supplied by relevant stakeholders and presented within documentation (such as the Section 19 Flood Investigation Report) has also been considered. This includes but is not limited to data provided by Thames Water Utilities Limited, London Fire Brigade and Transport for London. Additional data has been sourced from online news media to further develop context.

2.4.28 The streets affected during the 1975, 2002 and 2021 flood event are mapped in **Appendix A** (**Figure 5, Figure 6** and **Figure 7**). The mapping provides a reliable record of affected areas; however, it is relatively coarse in scale and does not allow for a distinction between isolated sections and entire street flooding.

2.5 Data Presentation

2.5.1 Mapped outputs have been generated to support information presented within the SFRA. These have been separated from the main body of text to allow for updates, if and where applicable.

3. Study Area

3.1 Overview

Location

3.1.1 The London Borough of Camden is located within the administrative boundary of the Greater London Authority (Greater London Authority), north of the River Thames. The Borough is approximately 22 km^2, comprising of notable areas such as Holborn, King's Cross, Bloomsbury, Belsize Park, Chalk Farm, Kentish Town, Highgate and Hampstead, refer to **Appendix A** (**Figure 3**).

3.1.2 There is a high contrast between residential districts and several areas of relative deprivation[12]. Large commercial hubs are in the central and southern region of the Borough, with smaller business areas located in the north and west. Hampstead Heath is the largest greenspace, covering over 3 km^2.

3.1.3 The Borough is bordered by the administrative areas of the City of Westminster, the City of London and the London Boroughs of Brent, Barnet, Haringey, and Islington.

Historic Flooding

3.1.4 Notable flood events within the London Borough of Camden have occurred in 1975, 2002 and 2021. The streets which had reported incidents of flooding during these events are presented in **Appendix A** (**Figure 4**).

3.1.5 The floods were largely driven by high volumes of surface water, which was caused by an intense rainfall event. The high volumes of surface water led to surcharge of the drainage infrastructure, which increased the severity of the flood event. Further details of the cause and impacts of these events, and sources of information used, is presented within **Table 3-1**.

Table 3-1: Notable Historic Flood Events

Flood Event	Cause	Areas Impacted
14th August 1975	Severe storm, with 150mm of rain falling in two and a half hours High volume of surface water Capacity of drain pipes, road gullies and sewers could not cope with the volume of surface water[13,43]	West Hampstead, South Hampstead, Gospel Oak, Kentish Town, Belsize Park, and Camden Town
7th August 2002	Intense rainfall, with 60mm of rain in under an hour High volume of surface water and exceeded drainage capacity Rainfall event considered a 1% AEP event (equivalent to 1 in 100 year)[13]	Euston Road, West Hampstead, South Hampstead, Kentish Town
21st and 25th July 2021	Prolonged and intense rainfall, which was highly localised. This contributed to saturated ground conditions Return period exceeded a 1% AEP event (equivalent to 1 in 100 year) in several areas Rainfall event exceeded the design standard for drainage systems, resulting in sewer surcharge[48]	Belsize Park, Swiss Cottage, Kilburn, West Hampstead, South Hampstead, Hampstead Town Centre, Kentish Town

3.1.6 Smaller scale flood events have occurred in the Borough as a result of groundwater, sewer, and drainage infrastructure failure. Heavy winter rainfall of 2012-2013 resulting in recorded incidents of basement and cellar flooding, due to groundwater flooding. There was a known incident of a water main pipe bursting on Kilburn High Road in July 2012[43] and more recently, a flood in December 2022 which occurred as a

[12] London Borough of Camden, Camden Profile – March 2023 [Online]. Available: https://opendata.camden.gov.uk/download/9m7e-5qyt/application/pdf [Accessed: 02/05/2023]
[13] London Borough of Camden, Camden Flood Risk Management Strategy (2013) [Online]. Available: https://www.camden.gov.uk/documents/20142/1458280/Camden_Flood_Risk_Management_Strategy.pdf/9e739029-02e5-59c7-e9a4-64d3622f2475 [Accessed: 03/05/2023]

result of a burst water main on Belsize Road[14]. Anecdotal evidence indicates the flood in December 2022 caused a flood depth of 0.5 m, impacting 100 properties.

3.2 Topography

3.2.1 High elevations of approximately 136 m Above Ordnance Datum (AOD) are recorded north of the Borough, comprising of Hampstead Heath and the neighbouring urban area; as presented in **Appendix A** (**Figure 8**). The terrain gently slopes toward the central area of the Borough and the southern boundary, where elevations fall to approximately 11 m AOD. This has been derived from a review of LiDAR Digital Terrain Model imagery, at a 2m grid resolution, available as an open data source.

3.3 Watercourses and Historic Rivers

3.3.1 There are no Main Rivers within the London Borough of Camden, as presented in **Appendix A** (**Figure 9**). All Main Rivers historically located within the Borough are now incorporated into the Thames Water Utilities Limited sewer network. These are referred to as 'lost' rivers and include the River Fleet, River Westbourne, and River Tyburn. **Appendix A** (**Figure 11**) presents a historic map (1804-1874) and depicts the likely conveyance of each 'lost' river through the London Borough of Camden.

3.3.2 The River Fleet rises on Hampstead Heath, feeding the Hampstead and Highgate Ponds. In the present day, the River Fleet is conveyed overland in Hampstead Heath and is subsequently subsumed into the combined Thames Water Utilities Limited sewer network at Hampstead No. 1 Pond and Highgate No. 1 Pond. From here, flows are conveyed in a south easterly direction, discharging to the River Thames, west of Blackfriars Bridge[15]. Historically, large sections of the River Fleet were conveyed overland, meandering through fields between Haverstock Hill and Kentish Town, and passing under Regent's Canal. The channel was first incorporated into the sewer network as the Fleet Trunk Sewer. Construction works were later undertaken in the 1870s to increase capacity of the network, to form the Fleet Storm Relief Sewer[16]. The Fleet Storm Relief Sewer runs roughly parallel to the earlier Fleet Trunk Sewer and follows the historic route of the river, toward Farringdon Road and the River Thames. It is conveyed underneath commercial hubs and key infrastructure, such as Camden Town and St Pancras railway station.

3.3.3 Online records indicate the River Westbourne (previously named the River Kilburn) rises in Hampstead Heath, at Whitestone Pond[17]. It was historically conveyed overland, flowing in a south westerly direction through Kilburn. Flows were subsequently conveyed away from the London Borough of Camden, toward Hyde Park and discharging to the River Thames, near to the Royal Hospital Chelsea[18]. In the 19th Century, sections of the river were used as part of the sewer network[19]. The channel was first culverted in 1827 and was completely submerged in 1871 due to urban development and increasing need for housing[21]. In the present day, flows are conveyed as a Thames Water Utilities Limited combined sewer. It is now known as the Ranelagh Sewer.

3.3.4 The source of the River Tyburn is found in South Hampstead, north of Primrose Hill[20]. Flows are conveyed in a southerly direction, toward Regent's Park and Victoria. The discharge point is found on the River Thames, near to Vauxhall Bridge[21]. All sections of the River Tyburn were converted to a combined sewer in 1860. Prior to this, only sections of the river were culverted. The River Tyburn now

[14] ITV News, Camden Flood: Residents cleaning up after water man bursts on Belsize Road [Online]. Available: https://www.itv.com/news/london/2022-12-19/homes-flood-a-week-before-christmas-after-water-main-bursts [Accessed: 02/05/2023]
[15] British History Online, The Fleet River and Fleet Ditch [Online]. Available: https://www.british-history.ac.uk/old-new-london/vol2/pp416-426 [Accessed: 02/05/2023]
[16] UCL River Fleet Restoration Team, The History of the River Fleet [Online]. Available: https://www.camden.gov.uk/documents/20142/1458280/River+Fleet.pdf/0f0063cc-7079-32c2-5822-6306dcd56d62 [Accessed: 02/05/2023]
[17] Londonist, London's Lost Rivers from Above: The Westbourne [Online]. Available: https://londonist.com/2009/11/londons_lost_rivers_from_above_the [Accessed: 02/05/2023]
[18] The Underground Map, The River Westbourne [Online]. Available: https://www.theundergroundmap.com/wp/tracing-the-westbourne/ [Accessed: 02/05/2023]
[19] The Rivers Trust, A Journey Along the River Westbourne [Online]. Available: https://theriverstrust.org/about-us/news/a-journey-along-the-river-westbourne [Accessed: 03/05/2023]
[20] Londonist, How to Catch a Glimpse of the Lost River Tyburn [Online]. Available: https://londonist.com/london/how-to-catch-glimpses-of-the-lost-river-tyburn [Accessed: 03/05/2023]
[21] Camden River Restoration, The History of Lost Rivers in Camden: The Historical Study of the Kilburn and Tyburn [Online]. Available: https://www.camden.gov.uk/documents/20142/1458280/Rivers+in+Camden.pdf/559155f8-645b-2e39-2669-3faacce135e6 [Accessed: 03/05/2023]

forms part of the Thames Water Utilities Limited combined sewer network, as the King's Scholar's Pond sewer[22].

3.3.5 The Regent's Canal waterbody extends from the Paddington Arm of the Grand Union Canal, through Camden Town and north of King's Cross Station, towards the River Thames; as presented in **Appendix A** (**Figure 9**). Further detail on the Regent's Canal is presented within **Section 5.6**.

3.4 Geology

3.4.1 The underlying geology can influence the presence and nature of groundwater in an area and can therefore affect the potential risk of flooding from groundwater. Geology can also impact the potential for infiltration based drainage systems. Bedrock geology is defined as the main mass of rock underlying surface materials such as soil and gravel. Superficial geology is defined as the youngest geological deposits which rest on bedrock and are often formed of unconsolidated elements.

3.4.2 The London Borough of Camden is predominantly underlain by the London Clay Formation bedrock type; as presented in **Appendix A** (**Figure 12**). This largely comprises of silty clays and clayey silt, in addition to sandy clay[23]. Areas north of the Borough are underlain by Claygate Member and Bagshot Formation bedrock, formed largely of sandy soil types.

3.4.3 Superficial deposits are prominent in the southern region of the London Borough of Camden; as presented in **Appendix A** (**Figure 13**). These include Langley Silt Member, Lynch Hill Gravel Member, Hackney Gravel Member and Alluvium. A localised area of Stanmore Gravel Formation is found north of the London Borough of Camden, in Hampstead Heath. These deposits are largely formed of sand, silt and gravels.

[22] Camden Council, London Borough of Camden Strategic Flood Risk Assessment (2014). [Online]. Available: https://www.camden.gov.uk/documents/20142/15822724/LB+Camden+Strategic+Flood+Risk+Assessment+2014.pdf/25379616-c452-b39b-9839-9f0c374cfa83 [Accessed: 26/04/2023]
[23] British Geological Survey, London Clay Formation [Online]. Available: https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=LC [Accessed: 03/05/2023]

4. Policy Context

4.1 National Planning Policy

4.1.1 National planning policy is the basis for regional and local planning policy and is critical to decision making and development. It ensures consistent action toward overarching objectives, helping the Local Planning Authority to set structured policies within their Local Plan. National policy supports the evolution of neighbourhood plans and justification of land allocated for development, and feeds into the approval of planning applications. The key national planning policies include the NPPF (2023), PPG and Environment Improvement Plan.

National Planning Policy Framework (2023)

4.1.2 The NPPF sets out the Government's planning policies for England, policy implementation and requirements for the planning system. It provides a framework within which local individuals and Councils can produce distinctive local plans, which reflect the needs and priorities of their communities. The NPPF informs the PPG and has been revised several times to reflect updates to wider Government policy and emerging proposals. The most recent revision is dated September 2023[1].

4.1.3 The overall approach to flood risk is broadly summarised in the NPPF (2023) Paragraph 167:

"When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

a. *within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*

b. *the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*

c. *it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*

d. *any residual risk can be safely managed; and*

e. *safe access and escape routes are included where appropriate, as part of an agreed emergency plan"*

As described under Paragraph 161 of the NPPF (2023), all proposals for development should account for all sources of flood risk and the current and future impacts of climate change. This can be achieved through:

a. *"Applying the sequential test and then, if necessary, the exception test;*

b. *safeguarding land from development that is required, or likely to be required, for current or future flood management;*

c. *using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and*

d. *where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations."*

Planning Practice Guidance

4.1.4 The PPG was first published by the UK Government in March 2014 and most recently updated in August 2022. The PPG acts as a catalogue of information, providing further context to the NPPF. Its primary purpose is for use in planning and decision-making and it is typically used by Local Authorities. However, it is a publicly available resource that can be used by community groups and other stakeholders. The guidance is separated into categories, the most relevant categories to the SFRA including 'Flood Risk and Coastal Change' and 'Climate Change'. Key information is detailed below.

Flood Risk and Coastal Change

4.1.5 The PPG advises how to take account of and address the risks associated with flooding and coastal change in the planning process.

4.1.6 Flood risk is defined as the combination of the probability and potential consequences of flooding. Areas at risk of flooding are those at risk from any source, now or in the future. Where flood risk is present, a Sequential Test should be applied in plan and decision-making. The Local Planning Authority is responsible for determining whether or not a planning application passes the Sequential Test.

4.1.7 Where suitable sites at lower risk of flooding are not available following the application of the Sequential Test, an Exception Test is required. This must be undertaken if the development is:

- Highly vulnerable and in Flood Zone 2;
- Essential Infrastructure in Flood Zone 3a or 3b; or
- More vulnerable in Flood Zone 3a.

4.1.8 The Exception Test should only be applied if the Sequential Test has shown there are no reasonable available, lower risk sites, suitable for the proposed development, and the development meets the criteria above. Developments subject to the Exception Test need to reduce flood risk overall, where possible. Further detail is provided within **Section 6.6**. The Exception Test is used to demonstrate that:

"The development that has to be in a flood risk area will provide wider sustainability benefits to the community that outweigh flood risk; and

The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."

4.1.9 The PPG defines Sustainable Drainage Systems (SuDS) as measures designed to control surface water runoff close to where it falls, combining a mixture of built and nature-based techniques to mimic natural drainage as closely as possible. It accounts for the predicted impacts of climate change and may provide benefit to the environment and water quality.

4.1.10 Consideration of SuDS early in the design process can lead to improved integration of measures and multi-functional benefits. The Local Planning Authority must consult the Lead Local Flood Authority on the proposed drainage arrangements. In this instance, the Lead Local Flood Authority is the London Borough of Camden. Long term maintenance of the SuDS should be included within the proposal for development. This could be arranged by, but not limited to the Lead Local Flood Authority, utilities company, community trust and private management company.

Climate Change

4.1.11 Guidance on climate change is included within the PPG to enable identification of suitable mitigation and adaptation measures in the planning process to address impacts of climate change. A SFRA forms part of the evidence base for the Local Plan, therefore information on climate change risks included within the SFRA is important to support local planning and decision-making.

4.1.12 The guidance considers future climate risks when allocating development sites, in addition to the impact and promotion of design responses to flood risk for the lifetime of the development. The document refers to Section 19 (1A) of the Planning and Compulsory Purchase Act 2004, whereby development plan documents must include policies that are designed to secure the development and use of land which contribute to the mitigation of, and adaptation to, climate change.

Environment Improvement Plan

4.1.13 The Environment Improvement Plan was published by the Department for Environment, Food and Rural Affairs (DEFRA) in January 2023[24]. It represents a revision of the 25 Year Environment Plan (2018)[25] and sets out the delivery of the environmental goals, in order to restore habitats and wildlife, promote sustainable use of resources and to improve the mitigation of climate change impacts. The framework for action is underpinned by national policy and spans a period of 25 years, running until 2043.

4.1.14 The Environment Improvement Plan outlines a series of actions to reduce risk of harm from environmental hazards. A large proportion of these actions seek to address flood risk, as detailed below:

- *"Deliver projects funded by the £100 million Frequently Flooded Allowance, as part of the capital programme of investment, to support communities who have suffered repeated flooding;*
- *Invest a further £22 million per year, on top of baseline funding, for maintaining […] flood defences between 2022 to 2023 and 2024 to 2025;*
- *Mitigate surface water flooding by making SuDS mandatory in new developments;*
- *Invest in improving […] flood forecasting capability for surface water flood risk".*

4.2 Regional Planning Policy

4.2.1 Regional planning policy captures policies which are specific to a geographic area, which are typically grouped by location and shared characteristics. The policies reflect the wider objectives of a region, such as economic development and large scale planning, in addition to cross boundary issues. Policies covering the area of Greater London, the Thames Catchment and the Thames River Basin District are relevant to the London Borough of Camden.

London Plan 2021

4.2.2 The London Plan was published in March 2021[26], outlining the integrated economic, environmental, transport and social framework for development of London over the next 20-25 years. It represents the most recent London Plan developed and has been developed in line with requirements set out in the Greater London Authority Act 1999 and Town and Country Planning (London Spatial Development Strategy) Regulations 2000. The document considers developments which are of strategic importance to Greater London.

4.2.3 The London Plan stipulates development proposals should account for climate change and the potential impact of low-lying land and impermeable surfaces on flood risk. Under Paragraph 9.5.12, is it also noted that "*development plans and proposals should demonstrate [consideration] for integrated solutions*" and emphasises the importance of an "*integrated and collaborative approach from developers*". This is of particular relevance when Lead Local Flood Authorities are cooperating on strategic and cross-boundary issues to address flood risk, such as management of London's waterways.

4.2.4 There are several policies detailed within the London Plan which are directly relevant to flood risk and its mitigation. Key details are outlined below.

Policy SI 12 Flood Risk Management

a. *"Current and expected flood risk from all sources across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers;*

b. *Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary,*

[24] HM Government. Environmental Improvement Plan 2023: First Revision of the 25 Year Environment Plan (2023). [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1133967/environmental-improvement-plan-2023.pdf [Accessed: 03/05/2023]
[25] GOV.UK Department for Environment Food and Rural Affairs. Policy Paper: 25 Year Environment Plan (2023). [Online]. Available: https://www.gov.uk/government/publications/25-year-environment-plan [Accessed: 03/05/2023]
[26] Greater London Authority, The London Plan (2021). [Online]. Available: https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf [Accessed: 03/05/2023]

to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London;

c. *Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses;*

d. *Developments Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including authorities outside London, to safeguard an appropriate location for a new Thames Barrier;*

e. *Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood;*

f. *Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way; and*

g. *Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat."*

Policy SI 13 Sustainable Drainage

- *"[…] Development proposals should aim to achieve greenfield runoff rates and ensure surface water runoff is managed as close to its sources as possible. There should be a preference for green over grey features, in line with the […] drainage hierarchy; and*
- *[…] Drainage should be designed and implemented in ways that promote multiple benefits, including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation."*

Policy D 10 Basement Development

- "Boroughs should establish policies in their Development Plans to address the negative impacts of large-scale basement development beneath existing buildings, where this is identified as an issues locally."
- "Local authorities are advised to consider the following issues, including any cumulative impacts, alongside other relevant local circumstances when developing their own policies for basement developments; local ground conditions; flood risk and drainage impacts… Where particular and cumulative flood risk issues exist, boroughs should consider restricting the use of basements for non-habitable uses."

London Regional Flood Risk Appraisal

4.2.5 The London Regional Flood Risk Appraisal was published by the Greater London Authority in September 2018, in cooperation with the Environment Agency[27]. The document provides a high-level overview of flood sources and the probability of flood events, acting as an evidence base for The London Plan and Local Plans within Greater London.

4.2.6 The London Regional Flood Risk Appraisal indicates growth is anticipated in London's major development locations and town centres, where individual risks should be examined through the Borough's SFRA. It is recommended that a detailed Flood Risk Assessment for these sites should be undertaken by developers at an early stage, alongside the Lead Local Flood Authority. The recommendation is directly relevant to Camden Town, which is described as a major centre with known

[27] Greater London Authority. London Regional Flood Risk Appraisal (2018). [Online]. Available: https://www.london.gov.uk/sites/default/files/regional_flood_risk_appraisal_sept_2018.pdf [Accessed: 05/05/2023]

surface water flood risk issues. The document indicates that in Camden Town alone, 3.7% of the total area is at risk of a 3.33% AEP event and 8.2% is at risk of a 1% AEP event. This is equivalent to a 1 in 30 year event and 1 in 100 year event, respectively. It accounts for a combined risk of flooding, including surface water, fluvial and tidal sources.

4.2.7 The document includes a general location of emergency services, schools and hospitals that are at risk of flooding within the London Borough of Camden.

4.2.8 Relevant recommendations outlined within the London Regional Flood Risk Appraisal are summarised below:

- Development should reduce surface water discharge in line with the Sustainable Drainage Hierarchy and actions within the London Sustainable Drainage Action Plan;
- Thames Water Utilities Limited should work collaboratively with Lead Local Flood Authority and the Environment Agency to facilitate attenuation of surface water. For the combined sewer networks, surface water has to be attenuated at source and discharged to sewer at a lower rate;
- Groundwater flood risk should be considered in SFRA and Flood Risk Assessment;
- Reservoir flood risk should be considered in SFRA and Flood Risk Assessment, and appropriate emergency plans should be in place;
- Where required, a detailed Flood Risk Assessment for individual major development locations and town centre development sites should be undertaken by developers at an early stage. Developers should work with relevant Lead Local Flood Authority(s) and opportunities to reduce flood risk maximised where possible;
- Relevant transport authorities and operators should examine and regularly review their infrastructure assets and flood risk reduction measures. Blue green infrastructure should be considered for large stations and depots to attenuate and disperse rainwater, and highways flood management measures should also include diversionary routes;
- Emergency service authorities and operators should review emergency plans regularly. These plans should put in place cover arrangements for other suitable facilities. Emergency services should consider flood protection and SuDS to reduce risk;
- Education authorities should ensure emergency plans are in place and reviewed regularly for facilities in flood risk areas. Education authorities should consider flood protection and SuDS to reduce risk; and
- Operators of electricity, gas, water, sewerage and utility sites should maintain up to date assessment of flood risk to their installations and establish necessary protections measures.

Thames Estuary 2100 Plan

4.2.9 The Thames Estuary 2100 Plan (TE 2100) was most recently published in April 2023. The TE 2100 details how the Environment Agency and relevant partners can manage tidal flood risk in the Thames Estuary[28], and considers the increasing risk of tidal flooding posed by climate change, ageing flood defences and population growth. Through an adaptive approach, the TE 2100 aims to protect the social, cultural, and commercial value of the tidal Thames area and floodplain, whilst promoting sustainable and resilient development.

4.2.10 The plan is advocated by the National Flood and Coastal Erosion Management (Flood and Coastal Erosion Risk Management) Strategy (2020)[29] and is divided into three distinct phases, undertaken between 2012 and 2100.

4.2.11 The Thames Estuary area is split into Policy Units to facilitate decision-making on a local scale, aided by Local Councils. The London Borough of Camden administrative region is not situated within a Policy

[28] Environment Agency. Policy Paper: Thames Estuary TE2100 Plan (2022). [Online]. Available: https://www.gov.uk/government/publications/thames-estuary-2100-te2100/thames-estuary-2100-te2100 [Accessed: 02/05/2023]
[29] Environment Agency, National Flood and Coastal Erosion Risk Management Strategy for England (2022). [Online]. Available: https://www.gov.uk/government/publications/national-flood-and-coastal-erosion-risk-management-strategy-for-england--2 [Accessed: 24/07/2023]

Unit area[30], meaning there is no specific strategy to be applied by the London Borough of Camden. However, the southernmost boundary of the Borough is within 1 km of the TE 2100 Plan Area. Therefore, it is important to consider TE 2100 as part of an integrated approach to flood risk. The policy of neighbouring Boroughs, which include the City of Westminster and City of London, is '*take further action to reduce the risk of flooding*'[31]. In this area, fluvial flooding from the Thames is unlikely to be a problem as the fluvial flood levels would not overtop the defences, however the Thames Barrier protects the area by controlling tidal water levels[32]. The Environment Agency and relevant partners need to upgrade the defence to mitigate against future sea level rise.

Thames River Basin District – River Basin Management Plan

4.2.12 The Thames River Basin District – River Basin Management Plan was first published by the Environment Agency in December 2015[33]. The River Basin Management Plan was updated in October 2022 and refined in December 2022[34], in accordance with updates required under the Water Framework Directive (WFD). The document provides a framework for protecting and enhancing the benefits provided by the water environment.

4.2.13 The London Borough of Camden is found within the Thames River Basin District and London management catchment. The management catchment is described as a dense urban area with complex and conflicting socio-economic pressures. Development has led to major modifications to most rivers and severe pollution. However, despite the built-up urban areas, the remaining rivers serve as green corridors in the urban centres[35].

4.2.14 Since the first publication of the River Basin Management Plan (2015), 1,230 km of waterbodies within the Thames River Basin District were enhanced and 70 km of waterbodies protected[36]. This is inclusive of all waterbodies, such as lakes and groundwater. Enhancements were aided by the 851 actions delivered through Environment Agency programmes and catchment-based approach partnerships.

4.2.15 The summary programmes of measures[37] indicates involvement of various stakeholders in the delivery of measures, including but not limited to the Environment Agency and Local Authorities. At the time of writing, there is no specific mention of the London Borough of Camden within the summary programmes of measures.

4.2.16 It is noted that public bodies 'should ensure the environment objectives of the River Basin Management Plan are reflected in their processes' and that 'all partners will need to work together to embed these principles across all water management initiatives'. This is of particular relevance to the London Borough of Camden due to the high connectivity of urban areas and waterways, such as Regents Canal, which are shared with the neighbouring boroughs.

[30] Department for Environment, Food and Rural Affairs & Environment Agency. List of Policy Units by Local Council – Thames Estuary 2100. [Online]. Available: https://www.gov.uk/guidance/list-of-policy-units-by-local-council-thames-estuary-2100 [Accessed: 24/07/2023]
[31] GOV.UK Department for Environment, Food and Rural Affairs & Environment Agency. Guidance: Managing Future Flood Risk and Thames Barrier – Thames Estuary 2100 (2003). [Online]. Available: https://www.gov.uk/guidance/managing-future-flood-risk-and-thames-barrier-thames-estuary-2100#flood-policies [Accessed: 03/05/2023]
[32] GOV.UK Department for Environment, Food and Rural Affairs & Environment Agency. Guidance: London City Policy Unit – Thames Estuary 2100 (2023). [Online]. Available: https://www.gov.uk/guidance/london-city-policy-unit-thames-estuary-2100 [Accessed: 03/05/2023]
[33] Environment Agency. Water for Life and Livelihoods: Part 1 – Thames River Basin District – River Basin Management Plan 2015. [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718342/Thames_RBD_Part_1_river_basin_management_plan.pdf [Accessed: 05/05/2023]
[34] GOV.UK. Guidance: Thames River Basin District River Basin Management Plan – Updated 2022 (2022). Available: https://www.gov.uk/guidance/thames-river-basin-district-river-basin-management-plan-updated-2022 [Accessed: 05/05/2023]
[35] Environment Agency. Catchment Data Explorer: London Management Catchment (2021). Available: https://environment.data.gov.uk/catchment-planning/ManagementCatchment/3049 [Accessed: 05/05/2023]
[36] Environment Agency, Guidance: River basin management plans, updated 2022 – progress report (December 2022) [Online]. Available: https://www.gov.uk/government/publications/river-basin-management-plans-updated-2022-progress-report/river-basin-management-plans-updated-2022-progress-report 05/05/2023
[37] Environment Agency. Catchment Data Explorer: Measures Data for England. Available: https://environment.data.gov.uk/catchment-planning/v/c3-plan/England/measures [Accessed: 05/05/2023]

Thames Water Drainage and Wastewater Management Plan

4.2.17 The Thames Water Drainage and Wastewater Management Plan was published by Thames Water Utilities Limited in May 2023[38] and will be used to inform the Thames Water Utilities Limited business plan for 2025-2050[39]. The document provides a strategic view of risk and possible interventions within the Thames Water Utilities Limited service region for the next 25 years. It explores how the pressures of a changing climate, growing population and land use change may be alleviated through delivery of resilient infrastructure, improvement to wastewater systems and drainage networks, reduced impact on the environment and improved maintenance for the next 25 years.

4.2.18 Risk assessments were undertaken for the Drainage and Wastewater Management Plan. The analysis for London suggested a 54% increase in properties at risk of internal sewer flooding for a 3.33% AEP event, and a 30% increase for properties at risk of internal and external sewer flooding for a 2% AEP event[38]. Although it was acknowledged that the overall impact on Greater London will be mitigated by the Thames Tideway Tunnel (25 km combined sewer), if consequences of population growth are left unmitigated, risk of sewer flooding into residential and commercial properties could increase by 4,000 every year. This could have an impact on areas such as the London Borough of Camden. To mitigate these challenges, Thames Water Utilities Limited note the importance of innovation and continued investment.

4.2.19 The strategic intent for the London asset base is to implement a re-greening programme, which adopts a 'SuDS-first' approach to reducing and slowing the rate and volume of rainwater entering the sewers. The Drainage and Wastewater Management Plan suggests measures, such as upsizing, retention tanks and property level protection, will be required to support the SuDS implementation due to the scale the challenges. The targets for Greater London are as follows:

- Sewer flooding: 95% of properties are protected from sewer flooding in a 2% AEP event;
- Storm overflows: no more than 10 discharges per overflow on average per year, by 2045; and
- Treatment: 100% permit compliance by enhancing resilience at the Sewerage Treatment Works.

4.2.20 The targets will be achieved through infrastructure development, stakeholder engagement, improvement and maintenance of assets. This includes increase of SuDS delivery to over 6,914 ha, relining and upsizing existing sewers, creating new sewers, improvements to surface water modelling and provision of active and passive flood protection measures. Although no specific reference is made to the London Borough of Camden within the Drainage and Wastewater Management Plan, the Borough is referenced within the Catchment Strategic Plan produced for the Beckton System (hereafter referred to as the Beckton CSP) in June 2023[40].

4.2.21 The Beckton CSP supports the Drainage and Wastewater Management Plan and describes the preferred solutions to reduce risk and impact of flooding, according to varying Risk Zones. The London Borough of Camden is located within Risk Zone 4, where preferred solutions include catchment level planning (including mapping and modelling), individual property level protection, deep tanks and tunnels and network improvements. Solutions such as deep tanks, tunnels and network improvements are risk mitigations considered for the 2030-2035 and 2035-2050 period.

Thames Catchment Flood Management Plan

4.2.22 The Thames Catchment Flood Management Plan was published by the Environment Agency in December 2009[41]. The policies and information set out in the Thames Catchment Flood Management Plan are used to inform planning and decision-making processes for the sustainable management of flood risk within the catchment area, taking climate change into account Although the document

[38] Thames Water, Our Draft Drainage and Wastewater Management Plan 2025-2050: The Draft Plan (2022). [Online]. Available: https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management/our-dwmp#plan [Accessed: 05/05/2023]
[39] Thames Water, News Article: Thames Water Sets Out its 25 Year Collaborative Plan for Drainage and Wastewater Services (2022). [Online]. Available: https://www.thameswater.co.uk/about-us/newsroom/latest-news/2022/jun/draft-drainage-and-wastewater-management-plan-published [Accessed: 05/05/2023]
[40] Thames Water, Catchment Strategic Plan: Co-Creating Resilient Wastewater Catchments – A Long Term Strategic Plan for the Beckton System (June 2023). [Online]. Available: https://www.thameswater.co.uk/media-library/home/about-us/regulation/drainage-and-wastewater/beckton-catchment-strategic-plan.pdf [Accessed: 28/07/2023]
[41] Environment Agency, Thames Catchment Flood Management Plan: Summary Report (2009). Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293903/Thames_Catchment_Flood_Management_Plan.pdf [Accessed: 09/05/2023]

considers all types of inland flooding, it focuses on fluvial flooding due to the limited data availability on surface water and groundwater sources at the time of writing.

4.2.23 The Thames Catchment Flood Management Plan Policies does not include the catchment area of the London Borough of Camden. However, the document examines flood risk of neighbouring catchments, such as the Lower Lee catchment. Consideration of flood risk and policy in these areas may be of benefit to decision making and developing an integrated approach to managing flood risk within the London Borough of Camden.

4.2.24 The Lower Lee catchment is located within Policy Option 5, defined as areas of moderate and high flood risk where further action to reduce risk can be taken. The proposed actions to implement Policy Option 5 are summarised below:

- Partners encouraged to develop policies, strategies and initiatives to increase resistance and resilience of new development to risk of flooding, and to identify opportunities for recreating river corridors in urban areas,
- Land and property owners to adapt the urban environment, through refurbishment of existing buildings to increase resistance and resilience to flooding, and
- Promote management of flood consequences, by improvement public awareness and local emergency planning.

4.3 Local Planning Policy

4.3.1 Local planning policy relates to the administrative area, such as the London Borough of Camden. The policies are tailored specifically to the needs and aspirations of the community and environment. The policies may reference local sites and consider the short and long term objectives. It is directly relevant to the area yet draws upon information and objectives outlined within regional and national planning policy.

London Borough of Camden Local Plan

4.3.2 The London Borough of Camden Local Plan is due to be adopted in 2026. The document will be informed by this SFRA and will set out planning policies and a vision for the Borough. The Local Plan will be critical to development of the area and delivery of the strategic objectives.

4.3.3 The most recent, publicly available version of the Local Plan was adopted in July 2017[42]. This outlines policies relating to economic growth, sustainable development, and resilience of local communities, for the period of 2017-2031. Policies within the Local Plan (2017) which are most relevant to the development and management of flood risk within the Borough include: “Policy CC2 – Adapting to Climate Change”, “Policy CC3 – Water and Flooding” and “Policy A5 – Basements”. Further detail on the policies can be found: Camden Local Plan 2017.

4.3.4 The publicly available Local Plan (2017) will be superseded by the new Local Plan. Once adopted, the new Local Plan should be used to inform development and delivery of strategic objectives.

4.3.5 The Local Plan (2017) sets out the growth strategy for the Borough over the period to 2031. Although the area offers a sustainable place for growth due to its existing infrastructure and transport links, there is limited land to accommodate growth. To meet the need for housing and economic growth, development may need to occur in areas at risk of flooding due to limited land availability. It is important to prioritise development within areas at least risk of flooding, which can be determined by the Sequential Test. Further detail on this is presented in **Section 6**.

Camden Flood Risk Management Strategy

4.3.6 The Camden Flood Risk Management Strategy was produced by Camden Council in December 2022, in their capacity as Lead Local Flood Authority[43]. The strategy sets out the approach to flood risk

[42] London Borough of Camden. Camden Local Plan (2017). [Online]. Available: https://www.camden.gov.uk/camden-local-plan1 [Accessed: 26/04/2023]
[43] London Borough of Camden. Managing Flood Risk in Camden: Camden’s Flood Risk Management Strategy (2022).

management for the period of 2022-2027, the involvement of key stakeholders and the likelihood of flooding across the Borough.

4.3.7 The Flood Risk Management Strategy emphasises the importance of stakeholder involvement in delivering strategic solutions to flood risk management. The key stakeholders and associated responsibilities are detailed in **Table 4-1**.

Table 4-1: London Borough of Camden - Key Stakeholder Responsibilities

Key Stakeholder	Responsibility
Camden Council	• Local Flood Risk Management Strategy • Surface water flood risk management • Groundwater flood risk management • Approval of new developments and associated development changes • Maintenance of owned assets
Highways Authorities: Camden Council Highways and Transport for London	• Highways drainage (before it reaches sewers) • Gully clearance • Maintenance of owned infrastructure
Thames Water Utilities Limited	• Sewer flood risk • Design and management of the drainage network • Maintenance of owned assets
Environment Agency	• Strategic oversight of flood risk management in England and Thames region • Management of Main Rivers and associated flood risk • Maintenance of owned assets
City of London Corporation	• Maintenance of owned assets
Land and Property Owners	• Protecting property from flooding and drainage (within the property boundary) • Building resilience to flood risk

4.3.8 The Flood Risk Management Strategy outlines the on-going activities for managing flood risk within the Borough, which fall under the responsibility of Camden Council. These include maintenance of an asset register, asset designation, maintenance of the London Borough of Camden owned assets, update of Camden's Multi-Agency Flood Plan, review Council flood warning and provision of information. Camden Council have a statutory duty to produce a Section 19 Flood Investigation Report for any significant flood events. The criteria for a significant event has been determined by Camden Council, in its capacity as Lead Local Flood Authority, and is as follows:

- *"The incident resulted in internal flooding of at least three properties; and*
- *There is ambiguity about the source or responsibility of the flood."*

4.3.9 In accordance with the criteria, the flood events of 12th and 25th July 2021 were classified as a significant event. A Section 19 Flood Investigation Report was published in July 2022 to present findings of the flood event; further detail is presented in **Section 4.3.21**.

4.3.10 There is '*no statutory obligation for the London Borough of Camden to deliver flood defence or alleviation schemes*', however in its role as Lead Local Flood Authority, Camden Council will seek opportunities to deliver flood risk alleviation projects across the Borough. Camden Council will prioritise schemes in areas where there is evidence of historic flooding, such as South Hampstead, South End Green and areas of West Hampstead and Kilburn. This will not preclude projects in other areas of the London Borough of Camden where one-off funding or opportunities through the planning system arise.

Opportunities for flood risk mitigation will be considered as part of initiatives such as Camden's Safe and Healthy Streets, Camden's Green Space Investment and Future Parks Accelerator programme.

4.3.11 The Flood Risk Management Strategy notes that Camden Council will continue to require all new basement developments to conduct a screening exercise to determine whether a full Basement Impact Assessment is required. This is applicable to residential and non-residential properties.

Camden Surface Water Management Plan

4.3.12 The Surface Water Management Plan for Camden Council was produced by Halcrow on behalf of Camden Council in July 2011[44]. The document outlines the preferred surface water management strategy for the London Borough of Camden, accounting for flooding from runoff from land, sewers, drains, groundwater, ditches and ordinary watercourses that occur from heavy rainfall. The Surface Water Management Plan formed part of the wider Drain London Tier 2 Study.

4.3.13 Local Flood Risk Zones and Local Critical Drainage Areas are defined by Camden Council and presented within the Surface Water Management Plan. Local Flood Risk Zones represent the actual spatial extent of predicted flooding in a single location, which affects houses, businesses, and local infrastructure. A Local Critical Drainage Area is defined as a 'discrete geographic area 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'. It is an area with known flooding problems, impacting people property and infrastructure. In this instance, the Local Critical Drainage Areas is not an area defined as having drainage issues by the Environment Agency.

4.3.14 The Local Flood Risk Zones and Local Critical Drainage Areas were identified through the Drain London Tier 2 modelling, which examined intense rainfall events, to understand the impact on flow paths, velocities, and catchment response.

4.3.15 Classification of a Local Critical Drainage Area is important, as development within these areas could contribute to the Local Flood Risk Zone. If a development is in Flood Zone 1 and is within an area with critical drainage problems a Flood Risk Assessment is required[45]. There are four Local Critical Drainage Areas and twelve Local Flood Risk Zones within the London Borough of Camden; this is presented within **Appendix A** (**Figure 16**). Proposals for addressing flood risk within each Local Critical Drainage Area is outlined within the Surface Water Management Plan.

4.3.16 Reference is made to the Counters Creek Catchment, which represents a large sewer drainage system that covers several boroughs, including the London Borough of Camden. Sewer flooding issues are attributed to the Counters Creek Catchment and connectivity between the upstream and downstream catchment areas. Over the last century, land use change and the growing population has increased the volume and velocity at which water enters the system. This places additional strain on the infrastructure, increasing the risk of sewer surcharge following heavy rainfall. As a result, an increase in the number of connections within upstream areas of the Counters Creek Catchment has led to increased risk of basement flooding in the downstream areas.

Preliminary Flood Risk Assessment

4.3.17 The Preliminary Flood Risk Assessment for the London Borough of Camden was published by Halcrow in 2011, on behalf of Camden Council as the Lead Local Flood Authority, as part of the Drain London project[46]. The document provides a high-level screening of significant local flood risk that does not originate from Main Rivers, sea, or large reservoirs.

4.3.18 The Preliminary Flood Risk Assessment indicates flooding of properties have occurred in the Hampstead area, Fairfax Road, and Finchley Road. The cause is largely attributed to surface water, gully blockage

[44] London Borough of Camden, Surface Water Management Plan (2011). [Online]. Available: https://www.camden.gov.uk/documents/20142/1458280/Surface Water Management Plan_Halcrow_Report_for_Camden.pdf/2a8fbf03-cbd7-e808-3bb4-e75b62756b0a [Accessed: 09/05/2023]
[45] Environment Agency & Department for Environment, Food and Rural Affairs. Guidance: Flood Risk Assessments in Flood Zone 1 and Critical Drainage Areas (2017). Available: https://www.gov.uk/guidance/flood-risk-assessment-in-flood-zone-1-and-critical-drainage-areas [Accessed: 09/05/2023]
[46] Preliminary Flood Risk Assessment – Drain London: London Borough of Camden. 2011. [Online]. Available: https://webarchive.nationalarchives.gov.uk/ukgwa/20140328171032mp_/http://cdn.environment-agency.gov.uk/flho1211bvli-e-e.pdf [Accessed: 09/05/2023]

and sewer surcharge. Groundwater is also acknowledged as a risk to areas south of the Borough, near to Euston Station, as a result of permeable superficial soils.

4.3.19 It is noted, future flood risk for extreme events is likely to be high, due to the highly urbanised landscape of the London Borough of Camden. The Preliminary Flood Risk Assessment emphasises the importance of developing plans for increased resilience and building capacity to adapt, whilst reviewing plans to achieve long term sustainable benefits.

Camden Multi-Agency Flood Plan

4.3.20 The Camden Multi-Agency Flood Plan was updated by Camden Council in April 2023[47]. The document covers a Borough based multi-agency response to a flood incident and is intended for all Category 1 and Category 2 responders under the Civil Contingencies Act 2004. Camden Council consulted several organisations to develop the Multi-Agency Flood Plan, including but not limited to: Thames Water Utilities Limited, Environment Agency, London Fire Brigade, Metropolitan Police (Camden), the Canal and River Trust, Transport for London and NHS England (London). The document is maintained and updated by the Emergency Management and Business Continuity team at Camden Council.

4.3.21 The Multi-Agency Flood Plan outlines the role and responsibility of emergency responders before, during and after a flood event, in addition to the response equipment which is available for use. Communication between emergency responders, the media and the general public is considered critical to managing risk and coordinating resource. Key information pertaining to process and risk from each flood source is outlined within the document. Surface water is considered to be of greatest risk to the London Borough of Camden, followed by flooding from groundwater and reservoir flood sources.

London Borough of Camden - Section 19 Flood Investigation (12th and 25th July 2021)

4.3.22 A Section 19 Flood Investigation Report for the flood event of 12th and 25th July 2021 was provided by AECOM on behalf of Camden Council in June 2022[48]. As Lead Local Flood Authority, Camden Council is required to produce a Flood Investigation Report for significant flood events within the Borough. The document details the sources, mechanisms and impacts of the July 2021 flood events, in addition to the RMA response to flooding.

4.3.23 The report concluded surface water and sewer flooding occurred as a result of extreme and highly localised rainfall event. This followed a period of prolonged rainfall, which led to saturated ground conditions and reduced the capacity for infiltration (i.e., the capacity of soil to absorb further rainfall). The highly localised nature of the rainfall event caused distinct variations in flood impacts across the Borough. The rainfall return period exceeded the design standards of drainage systems, leading to the surcharge of combined sewer networks. This led to a rapid onset of flooding and affected the capacity to predict the flood event. Although there was limited warning, it was found that Camden Council and other RMA were proactive in their response. The local community were also engaged and took an active role during the flood event.

4.3.24 High level recommendations are presented within the document centre upon improving communications, community resilience and understanding of integrated flood mechanisms. Key, non-statutory actions for Camden Council and Risk Management Authorities, such as Thames Water Utilities Limited and the Environment Agency, include but are not limited to ongoing partnership working, public consultation and studies of high risk areas within the Borough.

Neighbouring Borough's Strategic Flood Risk Assessment

4.3.25 As outlined within the London Plan (2021), cooperation is critical to successful management of cross-boundary issues. As such, this SFRA considers the flood risk management issues and strategies of neighbouring boroughs (as detailed within their SFRA reports), which include Barnet, Brent, City of London, City of Westminster, Haringey, and Islington.

[47] London Borough of Camden, Camden Multi-Agency Flood Plan (April 2023).
[48] London Borough of Camden. Section 19 Flood Investigation Report: 12th and 25th July 2021 (2022). [Online]. Available: https://www.camden.gov.uk/documents/20142/0/July+2021+Flood+Investigation+-+London+Borough+of+Camden+-+FINAL.pdf/ea22f061-4c05-a590-6240-02955630c2ef?t=1657007121150 [Accessed: 09/05/2023]

London Borough of Barnet

4.3.26 A joint Level 1 SFRA was developed for the London Borough of Barnet in March 2018, by the West London Alliance[49]. The West London Alliance was formed from the Greater London Authority Drain London Project in 2010[50], comprising the Boroughs of Barnet, Brent, Ealing, Harrow, Hillingdon and Hounslow.

4.3.27 The London Borough of Barnet is located north of the London Borough of Camden. The SFRA indicates the Borough is at risk of flooding from fluvial, surface water, sewer, groundwater, canal and reservoir sources. A high-level summary of the Local Plan and Flood Risk Management Strategy is provided within the SFRA. The summaries note the intent to reduce surface water runoff through SuDS and to manage runoff as close to the source as possible, subject to groundwater levels[51]. Local Requirements Validation Guidance Notes (2017)[52] are also included within the SFRA (under Section 4)[53]. These notes are specific to the Barnet Council administrative area and set out use of the Sequential Test and Exception Test, in line with the PPG. New development must demonstrate application of the sequential approach, if located in an area at risk from fluvial flooding.

4.3.28 The joint SFRA (2018) does not reference the London Borough of Camden in relation to cross boundary flood issues. The cross boundary flood issues are attributed to Main Rivers, which is not relevant to the London Borough of Camden due to the absence of Main Rivers.

London Borough of Brent

4.3.29 A joint SFRA was produced for the London Borough of Brent in March 2018, by the West London Alliance[2] (as described in **Section 4.3.26**).

4.3.30 The London Borough of Brent is located west of the London Borough of Camden. The SFRA identifies the London Borough of Brent to be at risk of flooding from fluvial, surface water, sewer, groundwater, canal and reservoir sources. Flood risk in the Borough may also be impacted by the Counters Creek ‘lost river’, which flows underneath the ground surface as a culverted watercourse. This is due to the potential risk of flooding from blocked culverts[54].

4.3.31 The Brent Local Plan and Flood Risk Management Strategy is referenced within the SFRA, which present the following key actions for the Borough including, close monitoring of the gully cleansing programme, targeted approach to gully clearing, designation of significant assets to improve maintenance and an asset register of the most significant flood assets within the Brent administrative area.

4.3.32 A Basement Supplementary Planning Document[55] is included within the SFRA (under Section 4)[53]. This provides guidance on planning matters relating to basement development, primarily basements of residential property extensions. The document stipulates that a basement dwelling of all types may be acceptable in Flood Zone 1 and 2, however a Flood Risk Assessment is required for proposals within Flood Zone 2. Self-contained basement dwellings, which have no internal access to the upper floors, are not permitted in Flood Zone 3a or 3b. Basement dwellings with access to upper floors may be acceptable in Flood Zone 3a, subject to satisfying the Exception Test.

4.3.33 The joint SFRA (2018) does not reference the London Borough of Camden in relation to cross boundary flood issues. The cross boundary flood issues are attributed to Main Rivers, which is not relevant to the London Borough of Camden due to the absence of Main Rivers.

[49] West London Alliance, West London Strategic Flood Risk Assessment: Executive Summary (2018). [Online]. Available: https://westlondonsfra.london/executivesummary/ [Accessed: 10/05/2023]
[50] West London Alliance, West London Strategic Flood Risk Assessment (2018) [Online]. Available: https://westlondonsfra.london/# [Accessed: 10/05/2023]
[51] West London Alliance, West London Strategic Flood Risk Assessment: Planning and Policy Framework (2018). [Online]. Available: https://westlondonsfra.london/2-planning-and-policy-framework/ [Accessed: 10/05/2023]
[52] London Borough of Barnet. Local Requirements Validation Guidance Notes (2017). [Online]. Available: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjYwfHfopj1AhWDnVwKHb3dDcMQFnoECAMQAQ&url=https%3A%2F%2Fengage.barnet.gov.uk%2F1161%2Fwidgets%2F3967%2Fdocuments%2F1041&usg=AOvVaw3ywKZvY-DZTeqbZMEmuPaS [Accessed: 10/05/2023]
[53] West London Alliance. West London Strategic Flood Risk Assessment: Flood Risk Assessment Guidance (2018). [Online]. Available: https://westlondonsfra.london/4-flood-risk-assessment-guidance-2-2/ [Accessed: 10/05/2023]
[54] West London Alliance. West London Strategic Flood Risk Assessment: Sources and Assessment of Flood Risk (2018). [Online]. Available: https://westlondonsfra.london/3-source-and-assessment-of-flood-risk/ [Accessed: 10/05/2023]
[55] London Borough of Brent. Basement Supplementary Planning Document (2017). [Online]. Available: https://legacy.brent.gov.uk/media/16406585/basement-spd-consultation-draft.pdf [Accessed: 10/05/2023]

City of London

4.3.34 The SFRA for the City of London was published by the City of London Corporation Council in April 2023[56], building upon previous SFRA documents developed in 2007, 2012 and 2017.

4.3.35 The City of London is located south of the Camden Borough. The City of London is considered to be at risk of flooding from surface water, fluvial, tidal, sewer and groundwater flood sources. The SFRA indicates surface water is the most likely cause of flooding within the area, due to the high density of commercial buildings and infrastructure, reduced drainage capacity and limited open space. The area is underlain by combined sewers, which contributes to the frequency of sewer flooding. However, construction of the Thames Tideway Tunnel project is expected to mitigate this risk, following the increased sewer capacity and consequently a reduction in overflows and backing up of water.

4.3.36 As noted within the SFRA, sewers within the City of London receive flows from the London Borough of Camden. Although this could pose a cross boundary flood risk in the event of backflow, construction of the Thames Tideway Tunnel project is expected to increase capacity and reduce overflow. As such, the potential for cross boundary issues between the City of London and Camden Borough is reduced.

4.3.37 The SFRA suggests artificial maintenance of groundwater levels and existing flood defences reduce the risk of flooding from fluvial, tidal and groundwater sources, thus is considered residual risk.

4.3.38 The GARDIT (General Aquifer Research Development and Investigation Team) maintains groundwater levels in the deep chalk aquifer below London to ensure that the risk of flooding from groundwater remains low. However, the SFRA identifies a risk of flooding from groundwater in superficial deposits near to the surface which sits on top of clay, which may arise from leaking pipes or high water levels in the Thames.

4.3.39 As the majority of land within the City of London is classed as Brownfield (land that has been previously developed), there are few areas of land specifically allocated for development. This creates challenges when applying the Sequential Test, as site allocation is not promoted within the Borough.

City of Westminster

4.3.40 The City of Westminster SFRA was published in 2019[57], by the City of Westminster Council. The City of Westminster is located south west of the Camden Borough.

4.3.41 The SFRA indicates that whilst the Borough has a significant area located within Flood Zone 2 and 3, the risk from fluvial and tidal sources is mitigated by the Thames Barrier and Thames Tidal Flood Defences which offer protection against a 0.1% AEP event. In addition, all areas of the Borough are at risk from surface water and sewer flooding, due to land use and the combined sewer network. There is also a residual risk of flooding from canals and potential risk from groundwater sources.

4.3.42 The SFRA suggests that, should a canal lock malfunction occur, water would flow east. In this instance, flows would be directed back towards the London Borough of Camden. Canal systems are well maintained and the risk of a lock malfunction is low, as such cross boundary flood issues associated with the canal system are considered unlikely.

4.3.43 Thames Water have an ongoing programme of maintenance and improvement works including pipe replacement and installation of Flooding Local Improvement Projects (FLIP) devices (non-return valves and pumps), of which the largest scheme is in Maida Vale, located adjacent to the western boundary of the Camden Borough. The Thames Tideway Tunnel which is due to be completed in 2025 will also divert and capture combined sewer overflow discharges to Beckton Sewage Treatment Works. Any cross boundary flood risks associated with failure of the FLIP devices is reduced, due to works of the Thames Tideway Tunnel.

4.3.44 The SFRA indicates the application of the Sequential Test is not practical as a tool to differentiate potential sites in the Borough, due to the nature of land use and limited availability of land. As development within the floodplain is generally considered sequentially acceptable in Westminster, development such as basements are considered through assessing flood risk vulnerability.

[56] City of London Corporation. City of London Strategic Flood Risk Assessment (2023). [Online]. Available: https://www.cityoflondon.gov.uk/assets/Services-Environment/city-of-london-strategic-flood-risk-assessment-2023.pdf [Accessed: 15/12/2023]
[57] City of Westminster. Draft Strategic Flood Risk Assessment (2019). [Online]. Available: https://www.westminster.gov.uk/media/document/en-env-010---draft-strategic-flood-risk-assessment [Accessed: 10/05/2023]

London Borough of Haringey

4.3.45 The London Borough of Haringey Level 2 SFRA was produced in February 2015 by JBA Consulting, on behalf of Haringey Council[58]. The SFRA updates and enhances the North London Level 1 SFRA (2008)[59] and exclusively examines flood risk within the London Borough of Haringey administrative area.

4.3.46 The London Borough of Haringey is located east of the Camden Borough. As noted within the SFRA (2015), surface water runoff is identified as the flood source of greatest potential risk to people and property across the Haringey Borough. Reservoir flooding is described as a significant residual risk and the perched water table renders areas of the Borough vulnerable to groundwater flooding. Anecdotal evidence suggested flooding due to drain surcharge during the flood event of April 2012.

4.3.47 Use of SuDS is recommended throughout the Borough, in line with the Flood and Water Management Act and Thames Catchment Flood Management Plan; as detailed in **Section 4.4** and **Section 4.2**, respectively. The SFRA notes future proposals should ensure the development does not encroach into the river margins and, where residual flood risk is present, open space of a development should be designed to act as flood storage area. An emphasis is placed upon increasing the capacity of surface water pathways and watercourses, such as the River Lea and its tributaries. Increased conveyance is acknowledged as an option, in the event it be accompanied by action to increase capacity of existing waterways. This is due to the potential loss of flood storage in the downstream reaches of the River Lea.

4.3.48 The SFRA stipulates any works to improve flooding along the River Lea and tributaries should be undertaken at a catchment scale. Therefore, the London Borough of Haringey is required to work with the Environment Agency and neighbouring boroughs, such as Camden Council, to prevent any detrimental impacts.

4.3.49 The SFRA (2015) does not indicate cross boundary flood risk issues between the London Borough of Haringey or Camden.

London Borough of Islington

4.3.50 The London Borough of Islington Level 1 SFRA was produced by Colas, Volker Highways and AECOM in August 2018, on behalf of Islington Council[60]. The document provides an update to the North London Level 1 SFRA (2008)[58]. The London Borough of Islington is located east of the Camden Borough.

4.3.51 The SFRA states the majority of Islington Borough is located within a Local Critical Drainage Area, therefore any development in areas of previously underdevelopment land is likely to have a negative impact on surface water flood risk. There is the potential for groundwater flooding along the eastern and western boundary, which border the Borough of Hackney and Camden, respectively. The areas at risk of groundwater flooding in proximity to the Camden Borough include Margery Street and Farringdon Road. The document notes the occurrence of internal and external sewer flooding incidents south of the Regent's Canal. It is possible that flooding from groundwater and the canal could impact the Camden Borough, due to proximity.

4.3.52 There are no Main Rivers located within the London Borough of Islington, therefore the Sequential Test considers flood risk from sources, including surface water, groundwater, sewers, canals, and reservoirs.

[58] London Borough of Haringey. Haringey Council Strategic Flood Risk Assessment (2015). [Online]. Available: https://www.haringey.gov.uk/sites/haringeygovuk/files/strategic_flood_risk_assessment_sfra_level_2_report.pdf [Accessed: 10/05/2023]
[59] North London Boroughs of Barnet, Camden, Enfield, Hackney, Haringey, Islington and Waltham Forest. North London Strategic Flood Risk Assessment (2008). [Online]. Available: https://www.nlwp.net/download/north-london-strategic-flood-risk-assessment/?wpdmdl=937&refresh=642ac3dfa81131680524255 [Accessed: 10/05/2023]
[60] London Borough of Islington. London Borough of Islington Strategic Flood Risk Assessment (2018). [Online]. Available: https://www.islington.gov.uk/-/media/sharepoint-lists/public-records/planningandbuildingcontrol/publicity/publicconsultation/20212022/20210718islingtonlevel1strategicfloodriskassessmentsfraaugust2018.pdf?la=en&hash=1755685DBBC3A92C53ABBCF16B0948B31A8CC84D [Accessed: 10/05/2023]

4.4 Water Legislation

Flood and Water Management Act (2010)

4.4.1 Following the devastating national floods of 2007, one of the recommendations from Sir Michael Pitt's review (2008)[61] was that 'the role of local authorities should be enhanced so that they take on responsibility for leading the co-ordination of flood risk management in their areas'. The Flood and Water Management Act (2010)[62] designates unitary authorities, such as the London Boroughs, as Lead Local Flood Authority. Lead Local Flood Authorities are encouraged to bring together relevant bodies and stakeholders to effectively manage local flood risk, which may include County, City and District/Borough Councils, Internal Drainage Boards (IDBs), highways authorities, water companies and the Environment Agency.

4.4.2 The new responsibilities the Act assigns to Lead Local Flood Authorities include:

- Coordinated management of flooding from surface water, ground water and ordinary watercourses,
- Development, maintenance, and implementation of a Flood Risk Management Strategy,
- Investigation and recording of local flood events,
- Establishment and maintenance of a Flood Risk Asset Register, and
- Ordinary watercourse regulation.

4.4.3 The Act gives Lead Local Flood Authorities the role of Sustainable Drainage Systems (SuDS) Approval Body where the Lead Local Flood Authority is responsible for adopting and maintaining SuDS. This means that planning applications which have drainage implications will need to be approved by the SuDS Approval Body before work can commence. The Lead Local Flood Authority are a statutory consultee on major planning applications in relation to surface water drainage. However, at the time of writing, legislation that places the Lead Local Flood Authority as a SuDS Approval Body had not yet been implemented. It is anticipated that this will be introduced in Winter 2024 where the Lead Local Flood Authority will have more authority to evaluate and approve drainage applications including inspecting and enforcing Statutory SuDS Standards.

4.4.4 The responsibility to lead and co-ordinate the management of tidal and fluvial flood risk remains that of the Environment Agency.

Flood Risk Regulations (2009)

4.4.5 The Flood Risk Regulations came into force in December 2009 which set out duties for the Environment Agency and Lead Local Flood Authority's in the preparation of a range of reports and mapping outputs. The regulations transposed the EU Floods Directive (2007/60/EC) which required Lead Local Flood Authority's to complete Preliminary Flood Risk Assessments. The Flood Risk Regulations were withdrawn in 2016.

4.5 Climate Change Allowances

Flood Risk Assessments: Climate Change Allowances

4.5.1 The Flood Risk Assessments: Climate Change Allowances guidance was first published by the Environment Agency in February 2016, to define when and how Local Planning Authority, developers and relevant stakeholders should use climate change allowances in Flood Risk Assessment[63]. It forms part of the wider Environmental Planning guidance and is regularly updated to reflect emerging

[61] The Pitt Review (2008). [Online]. Available: https://webarchive.nationalarchives.gov.uk/ukgwa/20100807034701/http:/archive.cabinetoffice.gov.uk/pittreview/_/media/assets/www.cabinetoffice.gov.uk/flooding_review/pitt_review_full%20pdf.pdf [Accessed: 27/04/2023]
[62] GOV.UK. Flood and Water Management Act (2010). [Online]. Available: https://www.legislation.gov.uk/ukpga/2010/29/contents [Accessed: 27/04/2023]
[63] Environment Agency. Guidance: Flood Risk Assessments – Climate Change Allowances (2022). [Online]. Available: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances [Accessed: 02/05/2023]

information and new projections. The most recent update was undertaken in May 2022, which accounts for UKCP19 projections.

4.5.2 The climate change allowances are applied during design, and scheme and strategy development. By making allowances, this helps to provide resilience to flooding and coastal change.

4.5.3 The allowances predict anticipated change for:

- Peak river flow;
- Peak rainfall intensity;
- Sea level rise; and
- Offshore wind speed and extreme wave height.

4.5.4 Where applicable, climate change allowances should be used to demonstrate how flood risk will be managed so that the development remains safe throughout its lifetime, taking climate change into account. The allowances are applied over a varying period of time and at varying percentiles, to account for the anticipated increase in climate change impacts.

4.5.5 Peak river flow, sea level allowances and offshore wind speed and extreme wave height climate change allowances are not appliable to the London Borough of Camden, due to the absence of Main Rivers and its geographical location. Although not appliable, peak river flow and sea level allowances are available for the wider London Management Catchment and the Thames River Basin (which is inclusive of the Camden Borough). The allowances are presented in **Appendix C** for reference only.

Peak Rainfall Intensity Allowances

4.5.6 Peak rainfall intensity climate change allowances are applicable to the London Borough of Camden. The allowances are presented within **Table 4-2**.

4.5.7 For peak rainfall intensity allowances, the development lifetime should be used to determine the relevant epoch. This is detailed below:

- Developments with a lifetime beyond 2100 should assess the upper end allowances (35% and 40%) for both the 3.3% and 1% AEP event respectively of the 2070s epoch;
- Developments with a lifetime between 2061 and 2100 should assess the central allowance (25% and 20%) for both the 3.3% and 1% AEP event respectively of the 2070s epoch; and
- Developments with a lifetime up to 2060 should assess the central allowance for both the 3.3% and 1% AEP event of the 2050s epoch. A temporary building (with a lifetime of less than 30 years) should assess the central allowance (20%) for the 3.3% and 1% AEP event respectively of the 2050s epoch.

Table 4-2: Climate Change Allowances – London Management Catchment and Thames River Basin

Type of Allowance		Camden Borough – Allowance Value	
Peak rainfall intensity allowance[64]: London Management Catchment Peak Rainfall Allowances		**3.3% AEP Event**	
		Central	Upper
	2050s	20%	35%
	2070s	20%	35%
		1% AEP Event	
		Central	Upper
	2050s	20%	40%
	2070s	25%	40%

[64] Environment Agency. Climate Change Allowances for Peak Rainfall (2022). [Online]. Available: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall [Accessed: 02/05/2023]

5. Flood Risk in the London Borough of Camden

5.1 Overview

5.1.1 The NPPF and PPG requires an SFRA to present information on all sources of flooding to allow the Local Planning Authority to apply the Sequential Test and identify areas at risk of flooding. A series of maps have been produced to support the report (**Appendix A**).

5.1.2 As detailed within the section below, the London Borough of Camden is at greatest risk of flooding from surface water and sewer sources. As evident from the significant flood events of 1975, 2002 and 2021, this is largely attributed to the dense urban landscape and lack of infiltration, which leads to large overland flows and surcharge of the combined sewer system. Areas underlain by a 'lost' river are at increased risk of surface water and sewer flooding, due to natural drainage processes and increased conveyance to the sewer network.

5.1.3 Areas of the London Borough of Camden located within the Counters Creek Catchment may have a greater risk of surface water and sewer flooding, should storage capacity of the wider catchment be exceeded. However, the overall impact is considered to be low due to the Borough's location within the upper catchment and as a result of the upcoming improvements associated with construction of the Thames Tideway Tunnel.

5.1.4 Canal systems and reservoirs within the Borough are well maintained and monitored. The reservoirs of Hampstead and Highgate Pond Chain are protected against a 1 in 10,000 year surface water flood event. However, there is residual risk from artificial sources.

5.1.5 There is low risk of flooding from fluvial sources. This is due to the absence of Main River watercourses and due to the active management of Hampstead Heath and Ordinary Watercourses within this area.

5.1.6 Climate change effects will increase the risk of flooding from surface water, sewer, and artificial sources. Although the scale of climate change effects cannot be accurately quantified, it is expected that rainfall events will become more extreme and there will be greater variability (i.e., periods of extended dry or wet weather), which could increase the scale and impact of a flood.

5.2 Surface Water Flooding

5.2.1 Surface water flooding and overland flow typically arise following a period of intense rainfall, which is often short in its duration. Flooding occurs due to the volume of rainfall that is unable to infiltrate into the ground or enter drainage systems. This is particularly true of heavily urbanised areas, due to the proportion of impermeable surfaces which inhibit infiltration. The subsequent overland flow is typically channelled along roads and pavements, causing localised flooding. Flooding from surface water sources is one of the main flood risks within the Camden Borough, and this risk is expected to increase under climate change scenarios.

5.2.2 The topography of the Borough contributes to the accumulation of surface water and flashy response to rainfall events. Surface water flows are conveyed from the northern region, which is characterised by high elevations, towards the lower elevations of the south. The largest flow pathways follow steep roads and pavements, which pond where the land is level. High flood water levels can appear over a short duration as a result of the topography and lack of permeable surface.

5.2.3 At the time of writing, a surface water flood model is in development for the area of Hampstead Heath and South End Green. This is due to be completed in 2023 and will be used to improve the understanding of flood risk in the local area.

Risk of Surface Water Flooding

5.2.4 The Risk of Flooding from Surface Water shows that for the model scenarios (3.33% AEP, 1% AEP and 0.1% AEP) the surface water flood extent broadly follows the natural topography of the Borough, including the alignment of man-made features such as roads and rail lines; as presented in **Appendix**

A (**Figure 15**). The dataset predicts the conveyance of large surface water pathways during a 0.1% AEP event, which typically follow the alignment of the 'lost' River Fleet.

5.2.5 Localised areas of surface water flooding are predicted near the Hampstead Heath ponds during the 1 in 30 year (3.33% AEP) event, which is classified as areas at high risk of surface water flooding. Flow paths are conveyed to the south of the Borough, passing through Dartmouth Park, South and West Hampstead, and localised areas of ponding in the 3.33% AEP event are also predicted in Camden Town which coincides with the fall of the topography.

5.2.6 The Risk of Flooding from Surface Water map aligns with historic records of surface water flooding within the Camden Borough, detailed in **Section 5.2.16.**

Local Critical Drainage Areas and Local Flood Risk Zones

5.2.7 As detailed in **Section 2.4**, Local Critical Drainage Areas and Local Flood Risk Zones are derived from the modelling undertaken as part of the Drain London Tier 2 Study (2010) and presented within the Camden Surface Water Management Plan. A direct rainfall method was used in the modelling approach and a conservative allowance for the drainage network and infiltration was applied. The extent of the Local Critical Drainage Area and Local Flood Risk Zone derived from the model are presented within **Appendix A** (**Figure 16**).

5.2.8 Local Flood Risk Zone represents the actual spatial extent of predicted flooding in a single location. As noted within the Surface Water Management Plan, this has been corroborated by modelled data, local knowledge, and records of historical incidents. It is also supported by the Risk of Flooding from Surface Water mapped outputs which indicate accumulation of surface water flow in these areas. Local Flood Risk Zones are generally located within Local Critical Drainage Areas throughout the Borough, with the majority found in the northern region of the Camden Borough.

5.2.9 A Local Critical Drainage Area is defined as a 'discrete geographic area 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'. A specific area within a Local Critical Drainage Area is not necessarily at higher risk than an area located outside of a Local Critical Drainage Area. However, developments within a Local Critical Drainage Area may contribute to a flooding hotspot.

5.2.10 As identified from the outputs of the Drain London Study, the majority of the Borough is located within a Local Critical Drainage Area, with the exception of the following areas: a narrow strip of land along the northern boundary of the London Borough of Camden, the western part of South Hampstead, and Hampstead Heath, an area to the east of Belsize Park. It is integral that surface water management practices are adopted for new developments, particularly those located within a Local Critical Drainage Area.

5.2.11 There are no greenfield sites available for development within the Borough. All land allocated for development is classified as brownfield land. Although no greenfield sites are available, it is important to incorporate appropriate surface water management measures for any development, to reduce runoff from the site post construction and to mitigate any negative impacts.

5.2.12 A review of Local Flood Risk Zones has been undertaken as part of this SFRA update. Two new Local Flood Risk Zones have been identified. These are located to the west of the Borough, 'Priory' and the north of the Borough, 'South End', as presented in **Appendix A** (**Figure 16**). These areas have been derived from anecdotal evidence of internal and external flooding during the 12th and 25th July flood events. For example, within the 'Priory' Local Flood Risk Zone, internal and external flooding was reported at Priory Terrace, Priory Road and Belsize Road. Within the 'South End' Local Flood Risk Zone, internal and external flooding was recorded at South End Road and Hampstead Hill Gardens. During the 2021 flood events, large surface water flows were conveyed along nearby roads, including Downshire Hill, Keats Grove and South Hill Park Gardens. For this reason, these roads have been included within the delineated Local Flood Risk Zone.

Counters Creek Catchment

5.2.13 The Counters Creek Catchment extends across several Boroughs north of the River Thames, including the Royal Borough of Kensington and Chelsea and the Boroughs of Hammersmith and Fulham, City of Westminster, Brent and Ealing and the London Borough of Camden. The catchment comprises an area

of approximately 85 km^2 of which 18% is within the Borough. The catchment area within the Borough is approximately 12 km^2; this is presented in **Appendix A** (**Figure 17** and **Figure 18**). As outlined in the Local Plan (2017), Thames Water Utilities Limited identified that the south east of the London Borough of Camden discharges storm flow into the Counters Creek drainage catchment.

5.2.14 Thames Water Utilities Limited records associated with the Drainage and Wastewater Management Plan[65] indicate there is a risk to property in connection to the Counters Creek Catchment, which extends west of the London Borough of Camden. Relative to the neighbouring Borough of Brent and the City of Westminster, areas in the London Borough of Camden appear to be at lower risk of internal and external flooding (based on predictive datasets); as presented in **Appendix A** (**Figure 17** and **Figure 18**). The indicative data suggests there is a greater risk of flooding to people and property in the downstream reaches of the Counters Creek Catchment. Therefore, areas in the upstream catchment, such as the London Borough of Camden, should introduce policy to limit discharge rates and minimise impact on the neighbouring Boroughs.

5.2.15 As suggested through the low rates of flooding associated from the Counters Creek within Camden, the Counters Creek Catchment has little direct impact on property flooding. However, drainage processes associated with the catchment may contribute to overall flood risk. This is more likely to have an impact on sewer flooding than surface water flooding, due to the extensive combined sewer network which conveys both foul and surface water; further detail is presented in **Section 5.4**.

Historic Records

5.2.16 Historic records indicate the London Borough of Camden has been significantly impacted by surface water flood events. As outlined in **Section 3.1**, notable events include 1975, 2002 and 2021. Evidence indicates areas in West Hampstead, South Hampstead and Kentish Town have been repeatedly affected by surface water flood events; as presented in **Table 3-1**.

5.2.17 The flood event of 14th August 1975 was caused by an extreme storm, which resulted in 150 mm of rainfall in two and a half hours[43]. The capacity of drain pipes, gullies and sewers were unable to cope with the high volume of surface water runoff in the short period of time. Flooded street records presented within the Flood Risk Management Strategy (2013)[13] suggest several areas north and north west of Camden Town were affected. This corresponds with anecdotal evidence of the event, which indicates West Hampstead was worst affected[66].

5.2.18 The 7th August 2002 flood event is described as less severe than the 1975 event[43 13], with 60 mm of rainfall in under an hour. However, the resultant damage on property and infrastructure was significant. The high volume of surface water runoff exceeded the capacity of drainage and sewer systems. Similar to the 1975 event, the flooded street records indicate areas north of Camden Town were affected. South Hampstead and West Hampstead were severely impacted by flooding, and parts of Kentish Town and isolated areas throughout the Borough also flooded. Following the event, Thames Water Utilities Limited invested in new flood risk infrastructure as part of the West Hampstead Flood Relief Scheme. The scheme was introduced to mitigate flooding on Sumatra Road and comprised measures to intercept and divert water flows toward a storage shaft on Maygrove Peace Park. The storage shaft provides approximately 1,322 m³ of storage during extreme rainfall events and is connected to the sewer network. It was designed to reduce risk of sewer surcharge to approximately 197 properties[43].

5.2.19 The 12th July and 25th July 2021 flood events occurred as a result of saturated ground conditions and an intense, highly localised rainfall event. The floods were preceded by the fifth wettest three-month combined May-June-July rainfall total on record[48], which saturated green spaces such as Hampstead Heath. This limited the capacity for attenuation at the point of peak rainfall, increasing the volume of surface water conveyed overland. The rainfall event had a high spatially variability, which led to a varying scale of impact across the Borough. Areas north and west of the London Borough of Camden, such as Hampstead and South Hampstead, were the worst affected. This corresponds with the areas of greatest rainfall intensity, where the most severe rainfall return period exceeded a 1% AEP event on 12th July[48].

[65] Thames Water Utilities Limited, Counters Creek Understanding Flood Risk and Long-Term Strategy Main Report. [Online]. Available: https://www.thameswater.co.uk/media-library/home/about-us/investing-in-our-region/counters-creek/counters-creek-main-report.pdf [Accessed: 10/01/2024]

[66] Ham and High News, Newspaper archives shed light on Hampstead Heath's great flood of 1975 [Online]. Available: https://www.hamhigh.co.uk/news/21384988.newspaper-archives-shed-light-hampstead-heaths-great-flood-1975/ [Accessed: 03/05/2023]

On the 12th and 25th July 2021, the return period rainfall exceeded the design standard of the sewer and drainage network. This led to surcharge of sewer assets and subsequent sewer flooding; further details are provided within the Section 19 Flood Investigation Report (**Section 4.3**). Over 100 incidents of flooding were reported for the July flood event. Findings of the Section 19 Report and further investigation undertaken by Camden Council suggest a significant number of properties were subject to internal flooding in July 2021. Most incidents reported by residents were considered a result of surface water.

5.3 Groundwater Flooding

5.3.1 Groundwater flooding occurs when the natural level of water stored within the ground rises above the local ground level. This typically occurs in low lying areas underlain by permeable rock and major aquifers, following a period of heavy or prolonged rainfall. Flooding from groundwater sources is slower to occur than other sources and can span several months after the heavy or prolonged period of rainfall.

5.3.2 Low lying areas may be more susceptible to groundwater flooding, as the water table is usually at a shallower depth and as groundwater flow paths tend to travel from high to low ground.

Susceptibility to Groundwater Flooding

5.3.3 The susceptibility to groundwater flooding maps provided by British Geological Society indicate a varying level of groundwater flood risk according to rock type and the estimated groundwater level[67]. The classifications rank from an order of highest to lowest risk: potential for groundwater flooding to occur at surface, potential for groundwater flooding of property situated below ground level, limited potential for groundwater flooding to occur and areas which are not susceptible to groundwater flooding (i.e.no classification assigned); as presented in **Appendix A** (**Figure 19**).

5.3.4 The London Borough of Camden is predominantly underlain by the London Clay Formation bedrock, which is predominantly clayey in nature; as presented in **Appendix A** (**Figure 12**). Although the upper part of London Clay Formation provides permeable horizons, the clayey nature of the bedrock type has low permeability and is of little significance as an aquifer[68]. Although groundwater may flow through fractures of the clay within the bedrock, flows will be significantly slower than other strata underlying the Borough[69]. There is little capacity for groundwater storage or conveyance, which suggests a limited risk of groundwater flooding. This is reflected in **Appendix A** (**Figure 19**) which shows large areas central and west of the Borough are not susceptible to groundwater flooding.

5.3.5 Areas north of the Borough, including Hampstead Heath, Hampstead and Highgate, are underlain by Bagshot Formation and Claygate Member bedrock; as presented in **Appendix A** (**Figure 12**). The sand within Bagshot Formation and Claygate Member is variably permeable, with capacity as an aquifer[70]. The bedrock is relatively permeable, when compared with the underling London Clay Formation. This allows for groundwater to flow through the bedrock, whilst the high porosity of deposits facilitates recharge of groundwater stores following rainfall events[69]. The deepest water tables are expected to occur within Bagshot Formation, of depths > 5m. Following a period of prolonged rainfall there is potential for groundwater flooding north of the London Borough of Camden, due to the capacity for groundwater storage. This corresponds with the area of limited potential for groundwater flooding, as presented in **Appendix A** (**Figure 19**). It is important to note, that whilst largely permeable, layers of low permeability clay are found within Bagshot Formation. This can lead to perched water tables, which affect slope stability. This should also be considered as part of a Basement Impact Assessment.

5.3.6 A small area south of the London Borough of Camden is underlain by the Lambeth Group bedrock type which comprises of variable sequences of clay, silty and sandy soil types[71]. Lambeth Group is typically characterised by high permeability[72]. The sand, silt and gravels allow for infiltration and flow through the upper layers of the geology, and the superficial deposits can support aquifers. However, permeability varies depending on the layer[73].

[67] British Geological Survey, Groundwater flooding FAQs. [Online]. Available: https://www2.bgs.ac.uk/groundwater/flooding/groundwaterHomesFAQ.html [Accessed: 09/10/2023]
[68] British Geological Survey, Baseline Report Series: 15. The Palaeogene of the Wessex Basin [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290916/scho0207blym-e-e.pdf [Accessed: 04/05/2023]
[69] London Borough of Camden, Camden Geological, Hydrogeological and Hydrological Study – Guidance for Subterranean Development [Online]. Available: https://www.camden.gov.uk/documents/20142/2247044/GHH+study.pdf/12f5a776-e382-21fe-8dbd-04ea4db575b3 [Accessed: 03/05/2023]
[70] British Geological Survey and Environment Agency, Baseline Report Series: 15. The Palaeogene of the Wessex Basin [Online]. Available: https://nora.nerc.ac.uk/id/eprint/3546/1/CR04254N.pdf [Accessed 03/05/2023]
[71] British Geological Survey, Bagshot Formation [Online]. Available: https://webapps.bgs.ac.uk/lexicon/lexicon.cfm?pub=British Geological Society#:~:text=The%20base%20of%20the%20Bagshot,gravelly%20sand%20developed%20in%20places. [Accessed: 03/05/2023]
[72] UK Centre for Ecology and Hydrology, Geology [Online]. Available: https://nrfa.ceh.ac.uk/content/geology [Accessed: 03/05/2023]
[73] British Geological Survey, Engineering Geology of British Rocks and Soils – Lambeth Group [Online]. Available: https://nora.nerc.ac.uk/id/eprint/503110/1/EngGeol_Lambeth_FINAL_1.02.pdf [Accessed: 03/05/2023]

5.3.7 Superficial deposits are found in the southern region of the London Borough of Camden; as shown in **Appendix A** (**Figure 13**). This comprises River Terrace Deposits, including Lynch Hill Gravel Formation, Hackney Gravel Formation and Langley Silt. The deposits form a thin layer, which is characterised by high permeability[74]. Although this allows for conveyance of groundwater, the capacity for storage is limited. The superficial deposits are underlain by London Clay Formation, which comprises of low permeability clays. This can lead to the accumulation of water within the River Terrace Deposits, resulting in isolated perched water bodies in the sandy layers of the London Clay Formation[69]. As such, there is an increased potential for groundwater flooding in the southern region of the London Borough of Camden; this is reflected in **Appendix A** (**Figure 19**) which shows areas south of the A501 to have potential for groundwater flooding of property situated below ground level and for flooding to occur at the surface.

Aquifer Designation

5.3.8 Aquifers are defined as layers of permeable rock or unconsolidated material (sand, gravel, silt etc.) capable of storing and transporting large quantities of water. The understanding of the behaviour and location of aquifers is important as they can provide an indication of the potential for groundwater flooding.

5.3.9 The majority of the London Borough of Camden is classified as 'unproductive'; as presented in **Appendix A** (**Figure 20**). The unproductive strata are largely unable to provide usable water supplies and are unlikely to have surface water systems dependent on them[75].

5.3.10 Areas to the north and south of the London Borough of Camden are underlain by a 'Secondary A' aquifer, including Hampstead Heath and Hampstead to the north, and Bloomsbury and Holborn to the south. Secondary A aquifers can support local water supply and may form an important source of base flow to rivers. The capacity for groundwater storage and flow conveyance in these areas increases the potential for groundwater flooding.

Source Protection Zones

5.3.11 Source Protection Zones are defined around large and public potable groundwater abstraction sites. They are protected by the Environment Agency from pollution and contamination as groundwater supplies a third of the UK's drinking water. The zones around location sites are defined by groundwater travel time to an abstraction.

5.3.12 As illustrated within MAGIC Map data[7], the 'Inner Protection Zone' (Source Protection Zone 1) is located south west of Primrose Hill park. The 'Outer Protection Zone' (Source Protection Zone 2) extends approximately 1 km northward towards the B509 road and South Hampstead area. The aim of Source Protection Zones is to identify particular areas where there are likely to be certain risks posed to quality and / or quantity of groundwater abstracted[76], should particular activities occur in the area.

5.3.13 Source Protection Zones within the London Borough of Camden are presented in **Appendix A** (**Figure 21**).

Basement Flooding

5.3.14 Construction of a basement can have a significant impact on the environment and adjoining properties, contributing to groundwater flood risk.

5.3.15 The water table could be encountered for basement developments located within the northern and southern region of the London Borough of Camden, in areas underlain by Bagshot Formation, Claygate Member and River Terrace Deposits. This is due to the permeable nature of sediment, which allows for storage and conveyance of groundwater. The rise and fall of the water table may increase risk of

[74] UK Centre for Ecology and Hydrology, Geology [Online]. Available: https://nrfa.ceh.ac.uk/content/geology [Accessed: 04/05/2023]
[75] Environment Agency, Guidance: Protect groundwater and prevent groundwater pollution (2017) [Online]. Available: https://www.gov.uk/government/publications/protect-groundwater-and-prevent-groundwater-pollution/protect-groundwater-and-prevent-groundwater-pollution#:~:text=6.2%20Secondary%20aquifers&text=secondary%20A%20aquifers%20comprise%20permeable,of%20base%20flow%20to%20rivers [Accessed: 04/05/2023]
[76] DEFRA, Source Protection Zones (Merged) [Online]. Available: https://environment.data.gov.uk/dataset/6fd0120f-d465-11e4-abee-f0def148f590 [Accessed: 04/05/2023]

groundwater flooding to a property, should groundwater emerge at the surface or within the basement structure.

5.3.16 Additionally, if a basement development is close to a well or a spring feeding surface water feature, the effect of groundwater taking a new flow pathway (as a result of obstruction) could result in reduced flow to a well or spring. Alternatively, a dormant spring may be reactivated or a new spring activated, causing groundwater to take a different flow path. A larger basement will have a large impact on the groundwater flow regime.

5.3.17 Within the Camden Geological, Hydrogeological and Hydrological Study (2010) the impact of basements on groundwater level is visually represented[77]; as presented in **Appendix D**. The illustration indicates adjoining basement structures create greater diversions in groundwater flow and a larger difference in water table either side of the structure/s. This may increase the risk of groundwater flooding, due to changes in flow and storage.

5.3.18 Groundwater flows within the River Terrace Deposits and Bagshot Formation would typically follow the course of 'lost' rivers, such as the River Fleet and River Tyburn[69]. Basement developments in proximity to the 'lost' rivers are therefore more likely to intercept a flow path and could increase groundwater flood risk.

Historic Records

5.3.19 The Flood Risk Management Strategy (2013) indicate a small number of recorded groundwater flood incidents within the Borough, occurring as a result of the heavy winter rainfall of 2012-2013. It is noted that risk from groundwater flooding is uncertain due to the limited information available. As such, incidents of groundwater flooding within the London Borough of Camden may be unrecorded.

[77] ARUP, Hydrogeological Figure 21-28 [Online]. Available: https://www.hampsteadforum.org/Plan/_ARUP_hydro-geological_figs_21-28.pdf [Accessed: 04/05/2023]

5.4 Sewer Flooding

5.4.1 Sewer flooding may occur where:

- The rainfall event exceeds the capacity of the sewer system/drainage system: As outlined in the Water Industry Act 1991, sewer systems are typically designed and constructed to accommodate rainfall events with a 3.33% AEP, equivalent to a 1 in 30 years event or less. Therefore, rainfall event with a return period of frequency greater than 3.33% AEP would be expected to result in surcharge of sections of the sewer system. While Thames Water Utilities Limited are concerned about the frequency of extreme rainfall events, it is not economically viable to build sewers that could cope with every extreme rainfall event.
- The sewer system becomes blocked by debris or sediment: If not adequately maintained and / or following a heavy rain event, there is potential for road gullies and drains to become blocked over time (e.g., from fallen leaves, build-up of sediment and litter). This may impact conveyance and can result in an accumulation of sewer and surface water flows, increasing the potential for surcharge of the system.
- The system surcharges due to high water levels in receiving watercourses: Where the local area is served by 'combined' sewers i.e., containing both foul and storm water, if rainfall entering the sewer exceeds the capacity of the combined sewer and storm overflows are blocked by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance, floodwaters will contain untreated sewage.

Sewer Network

Infrastructure

5.4.2 The majority of the London Borough of Camden is served by a combined surface and foul water system; as presented in **Appendix A** (**Figure 22**). All new sewers designed by Thames Water Utilities Limited are designed to cope with a 3.33% AEP event, plus an allowance for climate change[43]. Therefore, rainfall events with a return period of frequency greater than 3.33% AEP would be expected to result in surcharging of some of the sewer system. There are however areas of the Borough which are served by older sewer infrastructure. The sections of sewer are operated by Thames Water Utilities Limited and are potentially designed to only accommodate flows up to a 10% AEP event[78]. This includes the North West Storm Relief Sewer, which extends from West Hampstead in a south easterly direction, toward Oxford Road[79]. Rainfall events greater than 10% AEP would be expected to cause surcharge, therefore increasing the risk of flooding from sewer sources in these areas.

5.4.3 The combined sewer network is designed to outfall into the River Thames during intense rainfall events when the sewer network reaches capacity. However, there is evidence that during the 1975, 2002 and 2021 rainfall events led to surcharge of the local sewer network as a result of exceeded capacity (**Section 3.1**). This could occur when the combined sewer network cannot discharge to the River Thames, as a result of submerged outlets and where the sewer flow rate exceeds the rate of discharge to the River Thames.

5.4.4 As the majority of the London Borough of Camden is served by a combined sewer system, there is an increased risk for contaminated water to flood roads and / or properties during a flood event as a result of surcharge from surface water **and** foul water. .

5.4.5 Camden Council acknowledged that new developments could increase pressure on existing water infrastructure. Developers are required to liaise with the water utility company and demonstrate adequate infrastructure capacity, whilst adhering to Camden's local policies such as water efficiency by installing low flow toilets. The development should also achieve greenfield runoff rates, to reduce surface water runoff and subsequent volume of water entering the combined sewer network.

[78] Mouchel, North London Strategic Flood Risk Assessment (2008) [Online]. Available: https://www.walthamforest.gov.uk/sites/default/files/2021-12/ke79-north-london-strategic-flood-risk-assessment.pdf [Accessed: 04/05/2023]
[79] London Borough of Camden, Floods in Camden Report of the Floods Scrutiny Panel (2003) [Online]. Available: https://silo.tips/download/floods-in-camden-report-of-the-floods-scrutiny-panel-london-borough-of-camden [Accessed: 04/05/2023]

5.4.6 DG5 Records provided by Thames Water Utilities Limited detail the reported incidents of flooding which are considered to be linked to the sewer network. This is presented in **Appendix A** (**Figure 23**).

Counters Creek

5.4.7 The Counters Creek is a 'lost' river in north-west London, which was culverted in 1859 and is now integrated into the Thames Water Utilities Limited sewer network. The former river originated from Kensal Green in the Royal Borough of Kensington and Chelsea (Royal Borough of Kensington and Chelsea) and forms the eastern boundary of the Borough of Hammersmith and Fulham. The watercourse flows in a southerly direction to Chelsea Creek and Lots Road Pumping Station[80] before outfalling to the River Thames[81] near Imperial Wharf.

5.4.8 To mitigate flood risk associated with the Counters Creek, several measures were introduced as part of the Counters Creek Flood Alleviation Scheme (CCFAS)[82] in 2017. Thames Water Utilities Limited successfully implemented Flooding Local Improvement Projects (FLIPs) water pumps, local sewer upgrades and a SuDS scheme at Arundel Gardens in the Royal Borough of Kensington and Chelsea. Evidence suggests the CCFAS has reduced the volume of surface water runoff to the combined sewer network and has decreased the risk of basement flooding[83]. Measures may be required to mitigate the effects of climate change and impact on the Counters Creek Catchment, such as restricting discharge rate to sewers.

5.4.9 Areas of the London Borough of Camden within the Counters Creek Catchment are likely hydraulically connected to the downstream reaches, such as the Borough of Brent, City of Westminster and Royal Borough of Kensington and Chelsea. Evidence collated by Royal Borough of Kensington and Chelsea suggests the 2007 floods were caused by extreme rainfall in areas such as the London Borough of Camden[84], which led to exceeded sewer capacity in the downstream catchment area. This suggests a hydraulic connectivity between areas of the upper catchment (i.e. the London Borough of Camden) and the downstream catchment such as the Royal Borough of Kensington and Chelsea.

5.4.10 Should the Counters Creek Catchment reach storage capacity, this could impact the volume of surface water subsumed into the sewer network and may result in ponding, back flow, and surcharge of sewer infrastructure in the upstream catchment (such as the London Borough of Camden). However, the Thames Water Utilities Limited *Counters Creek - Understanding Flood Risk and Long-Term Strategy* (2023) report[85] indicates backing up of the system is localised and does not result in flooding. Thames Water Utilities Limited suggest the Thames Tideway Tunnel will reduce this risk. As such, the overall risk of the Counters Creek Catchment to flooding within the London Borough of Camden is considered low.

Historic Watercourses

5.4.11 As outlined in **Section 3.3**, the River Fleet, River Tyburn and River Westbourne were culverted and integrated into the local sewer network in the 19th Century. These are now referred to as 'lost' rivers.

5.4.12 The Fleet Storm Relief Sewer follows the historic route of the River Fleet and outfalls to the River Thames. The River Fleet historically drained a large proportion of the London Borough of Camden, therefore rainfall falling within the former broad catchment area is likely to flow into the Thames Water Utilities Limited combined sewer network in the present day.

[80] Royal Borough of Kensington and Chelsea, Royal Borough of Kensington and Chelsea Section 19 Flood Investigation: 12 July 2021 [Online]. Available: https://www.rbkc.gov.uk/media/document/chelsea-section-19-flood-investigation-12-july-2021---final-technical-report [Accessed: 03/05/2023]
[81] Londonist, Counter's Creek: In Search of London's Unknown River [Online]. Available: https://londonist.com/2016/02/counter-s-creek-probably-london-s-most-unknown-and-unloved-river [Accessed: 03/05/2023]
[82] Royal Borough of Kensington and Chelsea, Royal Borough of Kensington and Chelsea Section 19 Flood Investigation: 12 July 2021 [Online]. Available: https://www.rbkc.gov.uk/media/document/chelsea-section-19-flood-investigation-12-july-2021---final-technical-report [Accessed:03/05/2023]
[83] Mott MacDonald, Nature-based solutions: The complete SuDS package [Online]. Available: https://www.mottmac.com/amp/article/71207/counters-creek-flood-alleviation-scheme [Accessed:03/05/2023]
[84] Royal Borough of Kensington and Chelsea, Appendix 1 Subterranean Development Supplementary Planning Document (SDP) Final Adoption [Online]. Available: https://www.rbkc.gov.uk/howwegovern/keydecisions/reports%5Ccabinet%20member%20planning%20policy%20and%20housing%20policy%5Ckd03044ca.pdf [03/05/2023]
[85] Thames Water Utilities, Counters Creek – Understanding Flood Risk and Long-Term Strategy (Main Report) (2023). Online. Available: https://www.thameswater.co.uk/media-library/home/about-us/investing-in-our-region/counters-creek/counters-creek-main-report.pdf [Accessed:02/10/2023]

5.4.13 The River Westbourne (which now forms the Ranelagh Sewer) and the River Tyburn (which forms the King's Scholar's Pond Sewer) were culverted in the 19th Century. Both rivers are part of the Thames Water Utilities Limited combined sewer network. Similar to the River Fleet, rainfall within the catchment area of the River Westbourne and River Tyburn is likely to be subsumed into the sewer network.

5.4.14 The upper reaches of the River Westbourne and River Tyburn catchment includes areas west of the London Borough of Camden[21]. Investigation of the 2007 floods suggest extreme rainfall in the London Borough of Camden led to sewer flooding in Royal Borough of Kensington and Chelsea, which is indicative of flows from the former River Westbourne and Tyburn upper to the Thames Water Utilities Limited combined network.

5.4.15 DG5 records suggest multiple incidents of flooding from sewer surcharge and blockages in areas underlain by the 'lost' rivers. Main roads with several reported incidents of flooding from surcharge in the past 10 years are detailed in **Table 5-1**. It is not possible to determine whether the 'lost' river is the main cause of the sewer flooding, however it is likely a contributing factor.

Table 5-1: Reported Incidents of Sewer Flooding

'Lost' River	Main Road Affected
River Fleet	Highgate Road (2014 and 2016) Gray's Inn Road (2013, 2017 and 2021)
River Westbourne	Finchley Road (2013, 2015, 2016, 2017, 2019 and 2021) Belsize Road (2013, 2015, 2021 and 2022)
River Tyburn	Winchester Road (2013, 2017, 2020 and 2021)

Thames Water Sewer Mapping

5.4.16 The Borough is largely served by a combined foul and surface water network. There is a greater risk of flooding associated with combined networks, due to the contributions from property, roads, greenspace and related drainage infrastructure; as presented in **Appendix A** (**Figure 22**). The network serves a large number of properties, increasing inflows of foul water to the sewer system, whilst the large impermeable area of the London Borough of Camden inhibits capacity for infiltration and attenuation of surface water flows. Blockages within the sewer are more likely, due to transport of debris from road surfaces and disposed material from households and businesses.

5.4.17 The combined sewer network is responsive to storm events, due to the inflow of surface water. In the event of exceeded sewer capacity, external or internal flooding may occur as a result of surcharge. Properties directly underlain by the combined sewer may be at increased risk of flooding, due to proximity and potential for back flow.

5.4.18 There are small sections of foul and surface water sewers throughout the Borough, which connect to the combined network. As discussed in **Section 3.3**, the 'lost' rivers of the London Borough of Camden are integrated within the Thames Water Utilities Limited sewer network. The connectivity of the surface water sewer, foul sewer and 'lost' rivers increases the volume of water subsumed into and conveyed by the combined sewer network, further increasing risk of surcharge and subsequent flooding.

Historic Records

5.4.19 Thames Water Utilities Limited DG5 records for the period January 2013 to May 2023 suggest a total of 615 sewer related flood incidences within the London Borough of Camden; as presented in **Appendix A** (**Figure 23**). Although the cause of the flood incident cannot be stated with full certainty, the likely cause has been derived and is presented within the dataset. Over the past 10 years, sewer flood incidents are attributed to blockages, collapse of structures, overload, or back flow of the sewer network. The majority are considered a result of blockage, followed by overload of the network. Less than 25 records are attributed to collapse or blow back.

5.4.20 Roads within the London Borough of Camden with ≥10 reported incidents of sewer flooding in the past 10 years include: Belsize Road, Broadhurst Gardens, Camden High Street, Canfield Gardens, Fairhazel

Gardens, Finchley Road, Goldhurst Terrace, Haverstock Hill, Kentish Town Road, Southampton Row and West End Lane. Flooding at these locations typically occur above ground, however incidents of both above and below ground, and below ground are recorded.

5.4.21 Of the incidents recorded from Thames Water Utilities Limited since 2013, 134 are considered to cause internal *and* external flooding. A total of 6 incidents are described to have caused severe internal *and* external flooding, recorded at Belsize Road, Southampton Row and West End Lane. There are 5 reports of severe external only flooding on Burton Street, Holly Hill, Millfield Lane, Outram Place and West End Lane. There are 14 reports of severe internal only flooding on Glenloch Road, Kentish Town Road, New Oxford Street, Princeton Street, Southampton Row, Tottenham Court Road, Upper Park Road, West Heath Road and Willow Road. This accounts for combined, foul and private sewer systems.

5.4.22 Postcode areas with the greatest risk of flooding are typically located within the central and northern region of the Borough; as presented in **Appendix A** (**Figure 23**). From review of DG5 records, the postcode area with greatest risk of sewer flooding is 'NW6 3', with over 60 reported incidents between January 2013 and April 2023. The DG5 records indicate postcode areas 'NW6 4' and 'NW1 8' have between 41-60 reported incidents of sewer flooding over 10 years, and postcode areas 'NW6 1', 'NW3 6', 'NW3 2', 'NW3 4', 'NW1 7' and 'NW1 0' have between 21-40 incidents of reported flooding. The remaining areas of the London Borough of Camden have up to 20 reports of sewer flooding between January 2013 and April 2023. All areas are served by a Thames Water Utilities Limited combined sewer, as presented in **Appendix A** (**Figure 22**).

5.4.23 Anecdotal evidence and data from Thames Water Utilities Limited indicates several incidents of sewer flooding on the 12th and 25th July 2021, including Haverstock Hill, Winchester Road, Priory Terrace, Priory Road, Goldhurst Terrace and Belsize Road. This corresponds with reports of flooding within the DG5 records.

5.5 Fluvial Flooding

Main Rivers

5.5.1 As stated in **Section 3.3**, all Main Rivers historically located within the London Borough of Camden are now culverted and incorporated into the Thames Water Utilities Limited sewer network. As such, there is no fluvial flood risk from Main River sources within the Borough. This is represented within the Flood Map for Planning data, which shows that the administrative boundary of the Borough is located in Flood Zone 1, which is defined as land having a less than 0.1% AEP of flooding from fluvial sources; as presented in **Appendix A** (**Figure 14**). An assessment of flood risk from the 'lost rivers' is discussed in **Section 5.4.**

Ordinary Watercourses

5.5.2 An Ordinary Watercourse is a watercourse which is not part of a Main River. Ordinary Watercourses include rivers, streams, ditches, drains, culverts, dykes, sluices and sewers (other than public sewers). Flood risk from these watercourses is not often captured within the Flood Map for Planning dataset.

5.5.3 A review of the Ordnance Survey Open Rivers dataset shows there are three Ordinary Watercourses within the London Borough of Camden. This comprises two unnamed watercourses and the Ironstone watercourse, all of which originate from the high elevations of Hampstead Heath.

5.5.4 The Ironstone Ordinary Watercourse is conveyed in a north westerly direction, to the Leg of Mutton Pond, where flows are subsequently conveyed north through the Hampstead Town Ward and beyond the administrative boundary of Camden. The watercourse converges with the River Brent in the London Borough of Brent.

5.5.5 The two unnamed Ordinary Watercourses traverse the Borough in a southerly direction and are culverted as part of the Thames Water Utilities Limited sewer network, before outfalling to the River Thames. At the upstream extent of these two Ordinary Watercourses, several tributaries have formed in the depressions of the topography as small streams. These streams drain to the Hampstead Pond Chain, Highgate Pond Chain, Wood Pond, and Stock Pond, and do not extend beyond the boundaries of Hampstead Heath.

5.5.6 The risk of flooding from the Ironstone and the unnamed Ordinary Watercourses is considered low, due to ongoing active management of the ponds and landscape. The Hampstead Heath Ponds Project is a recent, large scale example of active management of the area; this is discussed in **Section 5.6**.

5.5.7 Flood outlines do not currently exist for most Ordinary Watercourses, as such, given no mapping showing the predicted extent of flooding is available, the Risk of Flooding from Surface Water dataset can be used as a proxy. Within the 1 in 1,000 (0.1% AEP) event, a surface water flow path closely follows the narrow corridor of each unnamed and Ironstone watercourses and the alignment of the 'lost rivers'; as presented in **Appendix A** (**Figure 11**). Localised areas within the immediate area of Hampstead Heath are shown to flood in the 1 in 30 year (3.33% AEP) event. The risk of surface water flooding is discussed in **Section 5.2.**

Flood Zones and Modelling Studies

5.5.8 The London Borough of Camden is located within Flood Zone 1 which is defined as land assessed as having less than 1 in 1,000 greater annual probability of river or sea flooding (≤0.1% AEP) in any year; as presented in **Appendix A** (**Figure 14**). Therefore, there is no flood risk from Main River and tidal sources within the London Borough of Camden.

5.5.9 To understand the proximity of fluvial flood extents from neighbouring Boroughs, the Environment Agency provided model outputs for the River Brent, River Lee, and Silk Stream, in addition to outputs for the tidal River Thames. As presented **Appendix A** (**Figure 29**), the flood extent of the River Brent, River Lee and Silk Stream do not extend to the London Borough of Camden under modelled scenarios for a 1% AEP scenario (plus climate change). The modelled flood extent for each river is found >1 km from the London Borough of Camden boundary, therefore the Borough is not considered at risk of flooding from these rivers.

5.5.10 The modelled flood extent of the 2005 and 2100 Thames Tidal Breach scenario are within 1 km of the London Borough of Camden southern boundary, however the flood extent does not infringe upon the boundary; as presented in **Appendix A** (**Figure 30**). No areas in the London Borough of Camden are within the extent of a breach scenario, therefore the Borough is not at residual risk of tidal flooding should the defences on the River Thames fail. The Thames Barrier and associated defences have a standard of protection up to a 0.1% AEP (1 in 1,000 annual probability) event[41].

5.6 Artificial Sources

Flooding from Reservoirs and Ponds

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

5.6.2 Under the Reservoirs Act 1975, Hampstead Pond No. 1, Highgate Pond No. 2 (also known as Highgate Men's Bathing pond) and Highgate Pond No. 3 (also known as Highgate Model Boating Pond) are classified as a large reservoir within the London Borough of Camden. Although the Maiden Lane reservoir is located outside of the London Borough of Camden administrative boundary, as discussed below, the modelled flood extent extends to the London Borough of Camden and so has been considered as part of this SFRA.

5.6.3 Review of the Environment Agency Reservoir Flood Maps[86] presents the predicted flood extent in the unlikely scenario of a reservoir breach. As described in **Section 2.4**, the 'wet day' scenario represents the predicted flood extent when rivers had already overflowed their banks, and the 'dry day' represents the flood extent when river levels are normal. This is presented in **Appendix A** (**Figure 24** and **Figure 25**).

5.6.4 During the 'wet day' scenario, the mapping shows that in the unlikely event of a reservoir failure at Hampstead No. 1 Pond, water would initially flow in a southerly direction, directed by the fall in topography towards the Hampstead Heath Rail and Overground Station, then eastwards as far as Gospel Oak. An area between West Hampstead Overground and Finchley Road and Frognal Overground is also shown within the predicted flood extents of a reservoir breach. In the unlikely event that Highgate Pond No. 2 and No. 3 fail, flood waters would extend approximately 3 km south toward Camden Town and King's Cross. The predicted flood extent of a breach at Highgate Pond No. 3 also extends east, beyond the boundary of the London Borough of Camden, toward Tufnell Park. The Maiden Lane reservoir flood extent is not provided within the 'wet day' scenario; as presented in **Appendix A** (**Figure 24**).

5.6.5 Under the 'dry day' scenario, the flood extent of the Hampstead No.1 Pond, Highgate Pond No. and No.3 are similar to that of the 'wet day' scenario, which follows roads and railway tracks to the south and east, to areas such as Gospel Oak, Camden Town and King's Cross; as presented in **Appendix A** (**Figure 25**)**.**

5.6.6 To reduce the possibility of dam breach, erosion and potential failure of the Hampstead and Highgate Pond Chain, the City of London Corporation funded the Hampstead Heath Ponds Project[87]. The project comprised of improvements to dam and overflow structures, in addition to the introduction of spillways. It was completed in 2016 and has reduced the risk of reservoir flooding, in the unlikely event of failure. Works undertaken for the Ponds Project significantly increased the Standard of Protection of the reservoir and dam structures, to protect against a 1 in 10,000 year surface water flood event[43]. The Hampstead Heath Ponds Project Preferred Solution Report[88] provides details of the preferred solutions explored as part of the Hampstead Heath Ponds Project. Measures have since been installed on the pond chains, which comprise: restoration of dam crests, raising of the existing dams, new open grass spillways and letterbox culvert spillways[89]. The City of London Corporation have developed an on-site

[86] Environment Agency, Long Term Flood Risk Mapping [Online]. Available: https://check-long-term-flood-risk.service.gov.uk/map [Accessed: 04/05/2023]
[87] Hampstead Heath Consultive Committee, Gateway 4c – Detailed Design Hampstead Heath Ponds Project [Online]. Accessed: https://democracy.cityoflondon.gov.uk/documents/s35824/Gateway%204c%20Detailed%20Design%20Hampstead%20Heath%20Ponds%20Project.pdf [04/05/2023]
[88] Atkins, Hampstead Heath Ponds Project: Preferred Solution Report (2014). [Online]. Available: https://democracy.cityoflondon.gov.uk/documents/s35825/Appendix%201%20-%20Atkins%20Preferred%20Solution%20Report.pdf [21/07/2023]
[89] Hampstead Heath Consultative Committee, Gateway 4c – Detailed Design: Hampstead Ponds Project. [Online]. Available: https://democracy.cityoflondon.gov.uk/documents/s35824/Gateway%204c%20Detailed%20Design%20Hampstead%20Heath%20Ponds%20Project.pdf [Accessed: 21/07/2023]

emergency response plan to be implemented in the unlikely event of flooding on Hampstead Heath, to mitigate risk to neighbouring areas.

5.6.7 The Maiden Lane Reservoir located within the London Borough of Islington is a covered service water reservoir owned by Thames Water Utilities Limited, which holds 67 million litres of water[90]. It is an operational service reservoir which is found immediately east of the London Borough of Camden border, located within Dartmouth Park. Recent site works include piling works in November 2021 and drainage improvements in July 2022. The proximity of the Maiden Lane Reservoir to the London Borough of Camden could pose a risk to the Borough, in the unlikely event of a breach where mapped data shows areas south and east of Dartmouth Park are within the predicted flood extent. The Flood Risk Management Strategy states the recent construction works to renew and reinforce the structure reduces the risk of reservoir flooding. The Maiden Lane reservoir flood extent is captured within the 'dry day' scenario and extends approximately 0.25 km east toward the Dartmouth Park residential area; as presented in **Appendix A** (**Figure 25**). The modelled outputs indicate a large proportion of the flood extent is however conveyed east toward the Borough of Islington.

5.6.8 Reservoirs in the UK have an extremely good safety record. The Environment Agency is the regulatory authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs >10,000m^3 must be inspected and supervised by reservoir panel engineers on an annual basis.

Flooding from Canals

5.6.9 Canals do not pose a direct flood risk given they are regulated water bodies with controlled water levels. However, flooding can still occur in the event of a breach or overtopping. Control structures such as weirs or locks could experience a blockage or failure resulting in rising water levels and overtopping. Structural failure could lead to a breach which can potentially be hazardous as they may involve the rapid release of large volumes of water at high velocity.

5.6.10 The Regent's Canal extends across the London Borough of Camden, through Camden Town and north of King's Cross Station. The water level within the Regent's Canal is controlled by a series of lock gates maintained and managed by The Canal and River Trust, as such, the risk of flooding as a result of overtopping or breaching is low. The Canal and River Trust have documented standards for asset inspection and management, which ensure the appropriate management of all The Canal and River Trust assets[91].

Infrastructure Failure

5.6.11 Flooding may result from the failure of engineering installations. Hard defences may fail through the slow deterioration of structural components. This is often difficult to detect, meaning that should failure occur it is often sudden and unexpected. Failure is more likely when a structure is under maximum stress, such as extreme fluvial flooding events.

5.6.12 There are no Environment Agency owned flood defences or AIMS structures within Camden Councils administrative boundary; as presented in **Appendix A** (**Figure 26**). There are no areas benefiting from flood defences within the Borough; as presented in **Appendix A** (**Figure 27**). This suggests there is no risk of flooding from infrastructure failure associated with river and sea defences.

5.6.13 Areas of Hampstead Heath are underlain by artificial drainpipes and channels to remove water from footpaths, sports pitches, and waterlogged areas[69]. The structures are small in scale, therefore in the unlikely event of failure, flooding will be localised to Hampstead Heath, with limited impact on property or infrastructure.

5.6.14 An inverted Thames Water Utilities Limited drainage siphon under the Grand Union canal along Gloucester Avenue has previously resulted in flooding and therefore updates on its condition and maintenance are requested annually from Thames Water Utilities Limited.

[90] Water Projects, Maiden Lane Reservoir (2022) [Online]. Available: https://waterprojectsonline.com/custom_case_study/maiden-lane-reservoir-2022/ [Accessed: 04/05/2023]
[91] Canal and River Trust, Our policies and procedures [Online]. Available: https://canalrivertrust.org.uk/the-publication-scheme/our-publication-scheme/our-policies-and-procedures [04/05/2023]

Historic Records

5.6.15 At the time of writing, there are no historical incidents of flooding as a result of reservoir failure or overtopping within the London Borough of Camden. The Canal and River Trust have also confirmed that no flood incidents associated with the Regent's Canal have been reported within the London Borough of Camden, including overtopping and breach scenarios.

6. Applying the Sequential Test

6.1 Overview

6.1.1 The sequential approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The Sequential Test ensures that a sequential, risk-based approach is followed to steer new development to areas with the lowest risk of flooding, **taking all sources of flood risk and climate change into account**. In the London Borough of Camden this includes flooding from surface water, sewers, groundwater, and artificial sources.

6.1.2 **Figure 2** (PPG Diagram 2[2]) illustrates the approach for applying the Sequential Test that Camden Council should adopt in the allocation of sites as part of the preparation of the Local Plan. Using the guidance in this Section, a standalone document should be produced by Camden Council which sets out the approach for applying the Sequential Test for plan making and developers.

6.1.3 The NPPF provides guidance on the suitability of a development based on its vulnerability to flooding. **Table 6-1** presents the vulnerability classifications assigned to different development types in accordance with the NPPF. **Table 6-2** shows when the Exception Test is required.

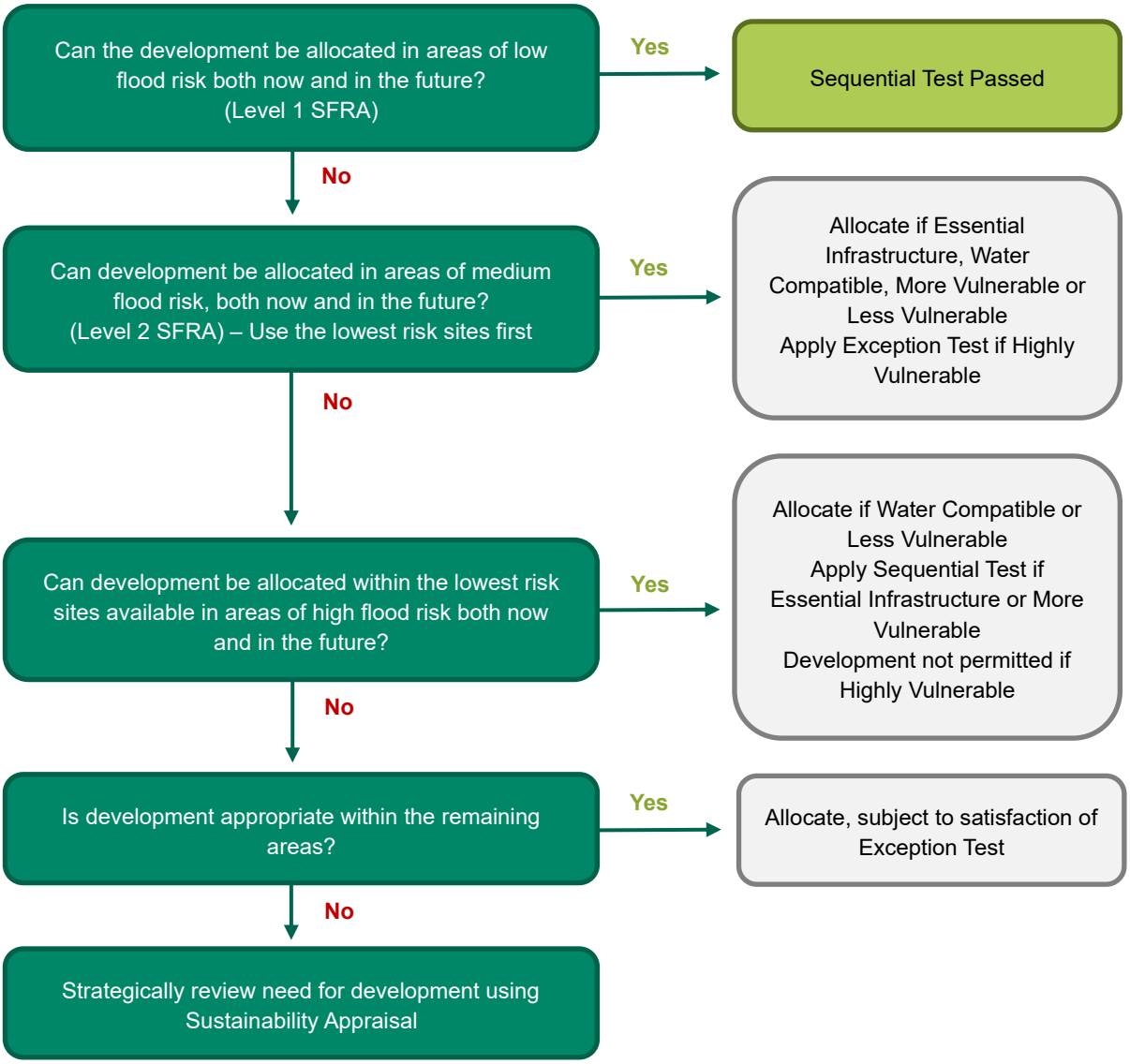


Figure 2: Application of the Sequential Test for Local Plan Preparation

Table 6-1: Flood Risk Vulnerability Classification (Annex 3 – PPG, 2021)

Vulnerability Classification	Land Use
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations storage; and water treatment works that need to remain operational in times of flood • Wind turbines • Solar farms
Highly Vulnerable	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding • Emergency dispersal points • Basement dwellings • Caravans, mobile homes and park homes intended for permanent residential use • Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure')
More Vulnerable	• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels • Non–residential uses for health services, nurseries and educational establishments • Landfill* and sites used for waste management facilities for hazardous waste • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding • Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure • Land and buildings used for agriculture and forestry • Waste treatment (except landfill* and hazardous waste facilities) • Minerals working and processing (except for sand and gravel working) • Water treatment works which do not need to remain operational during times of flood • Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place • Car parks
Water Compatible Development	• Flood control infrastructure • Water transmission infrastructure and pumping stations • Sewage transmission infrastructure and pumping stations • Sand and gravel working • Docks, marinas and wharves • Navigation facilities • Ministry of Defence installations • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location • Water-based recreation (excluding sleeping accommodation) • Lifeguard and coastguard stations • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan

Table 6-2: Flood Risk Vulnerability and Flood Zone 'Incompatibility' (Table 3 – PPG, 2022)

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

✓ - Exception Test is not required *✗ - Development should not be permitted*

† – In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

** – In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:*

- remain operational and safe for users in times of flood

- result in no net loss of floodplain storage

- not impede water flows and not increase flood risk elsewhere

6.2 Applying the Sequential Test in Camden

6.2.1 The London Borough of Camden is located entirely within Flood Zone 1, with a low probability of flooding from rivers and the sea.

6.2.2 The London Borough of Camden is at risk of surface water, sewer and groundwater flooding and there is some variation in this risk. Findings within this SFRA indicate surface water and sewer sources pose the greatest flood risk within the Borough. Historic flood events of 1975, 2002 and 2021 are attributed to surface water and sewer flooding, following intense rainfall events. Areas in the northern and southern region of the Borough are more susceptible to groundwater flood risk. Locations within proximity to the 'lost' rivers are also likely to be more vulnerable to flooding.

6.2.3 The Risk of Flooding from Surface Water mapping can be used to assess the differing level of risk from surface water sources within the London Borough of Camden. The 'very low', 'low', 'medium', and 'high' categories of the dataset refer to areas with varying risk of surface water flooding, as defined by the Environment Agency. Similarly, the outputs of the SFRA can inform whether a site is situated within a 'Previously Flooded Street', 'Local Flood Risk Zone', 'Lost River', postcode area identified within the 'DG5 sewer records' and/or an area with 'potential for groundwater flooding at the surface and below ground level'.

6.2.4 Parts of the London Borough of Camden may also be at residual risk of flooding from artificial sources such as reservoirs and canals in the event of a breach or overtopping of infrastructure.

6.2.5 The London Borough of Camden is heavily urbanised, meaning there is a limited number of reasonably available alternative sites against which to test future potential development sites. As such, use of the Sequential Test may be restricted. There remains an opportunity for the sequential approach to be applied *within* individual sites.

Applying the Sequential Test in Plan Making

6.2.6 All plans are required to take a sequential approach to the location of the development, taking into account all sources of flood risk and the current and future impacts of climate change, so as to avoid flood risk to people and property (where possible). Camden Council should assess all potential site allocations in relation to flood risk, using the data and information in this SFRA. Camden Council should steer development towards those sites with lowest risk of flooding before consideration of sites at greater risk.

6.2.7 **Table 6-3** helps to identify the level of risk experienced at a site which should inform the application of the Sequential Test. Sites may be identified as having single or multiple flood risk sources.

6.2.8 Following the application and satisfaction of the Sequential Test, all sites where flood risk has been identified, or include an area of 1 ha or more, are required to address these in a site specific Flood Risk Assessment. The FRA should demonstrate how the most vulnerable uses are located in areas at lowest overall risk, that the development will be safe and not increase flood risk elsewhere.

Applying the Sequential Test for Individual Planning Applications

6.2.9 All planning applications (exemptions apply) in the Borough will be expected to use this SFRA to identify whether their site is at risk of flooding from any source.

6.2.10 The London Borough of Camden is heavily urbanised and therefore the number of reasonably available alternative sites against which to test future potential development sites is very limited. As a result, Camden Council have taken the decision to consider all future development to satisfy the Sequential Test. **As such, it is not required for the developer to submit their own Sequential Test. Instead, Camden Council have developed more stringent requirements for when a Flood Risk Assessment is required and what development is permitted.**

6.2.11 It is recommended that a site-specific Flood Risk Assessment is required for the following:

- Major planning applications (providing 10 or more homes, the floorspace created by the development is 1,000 m^2 or more, or the site is 1 ha or more);
- Where a site is located within a:
  - Previously Flooded Street;
  - Local Flood Risk Zone;
  - An area identified within a postcode area where 41 + sewer incidents have been reported; and
  - Extent of flooding from surface water (high and medium risk) – see Risk of Flooding from Surface Water mapping.
- All basement developments located within a:
  - Previously Flooded Street;
  - Local Flood Risk Zone;
  - An area identified within a postcode area where 21+ sewer incidents have been reported;
  - Extent of flooding from surface water (high and medium risk) – see Risk of Flooding from Surface Water mapping;
  - Area underlain by a ‘Lost’ River; and
  - Area categorised as ‘potential for groundwater flooding to occur at the surface’ .

6.2.12 **Table 6-3** helps to identify the level of risk experienced at a site which should inform the Flood Risk Assessment.

Table 6-3: Key Considerations for Flood Risk Assessments: Flood Risk Source

Flood Risk Source	Detail
Previously Flooded Streets	The previously flooded streets data provided by Camden Council identifies the streets which flooded in the 1975, 2002 and 2021 flood events from surface water and sewer flooding. It is a good representation of flood risk, as the data reflects known incidents of flooding.
Sewer DG5 Records	DG5 Records provide information relating to sewer flooding within the Borough, on a postcode level. The records show areas which have been affected by sewer flooding. Sewer flooding is a known issue within the Borough, with instances of surcharge reported on multiple occasions (including the historic events of 1975, 2002 and 2021).
Surface Water Flow Paths	Surface water flow paths are represented by the Environment Agency Risk of Flooding from Surface Water dataset, which reflect differing levels of flood risk. Whilst the dataset is relatively broad and high level, it predicts the conveyance of surface water through the urban landscape.
Local Flood Risk Zone	Local Flood Risk Zones represent the actual spatial extent of predicted flooding in a single location which affects properties and infrastructure. The Local Flood Risk Zones were defined through the Drain London Tier 2 Surface Water Management Plan (2010) and accounts for the accumulation of surface water. Outputs have been corroborated by modelled data and local knowledge. The accumulation of surface water in the Borough has caused internal and external property flooding, in addition to disruption to key infrastructure.
Historic Rivers	Data illustrating the 'lost' rivers provided by Camden Council show the likely route of the River Fleet, River Westbourne (previously known as the River Kilburn) and River Tyburn. The rivers were culverted in the 19th Century and are now integrated into the Thames Water Utilities Limited sewer network. Although it is not possible to confirm the route through freely available datasets, a review of literature indicates the mapped outputs are a fair representation of the 'lost' river channels.
Susceptibility to Groundwater Flooding	Areas of Camden are susceptible to groundwater flooding, as identified through the British Geological Survey 'Susceptibility to Groundwater Flooding' dataset. Susceptibility to groundwater flooding is largely limited to the northernmost and southern region of the Borough. The mapping indicates that areas within the central region of the Borough are less susceptible to groundwater flooding. There are few reports of groundwater flooding within the Borough relative to that of surface water and sewer flooding. This may be linked to the level of risk, or the capacity to identify and report groundwater flood events. A known groundwater event occurred in the winter of 2012-2013, following prolonged rainfall.

6.2.13 Where a 'More Vulnerable' development (e.g. residential institutions, buildings used for dwelling houses, non-residential uses for health services, nurseries and educational establishments – as defined by Annex 3: Flood risk vulnerability classification (**Table 6-1**)) is proposed in an area with a potential flood risk, suitable mitigation measures, such as raising of finished floor levels, access levels and introducing raised thresholds to buildings, should be implemented in order to mitigate risks to property and people.

6.2.14 Proposals for 'Highly Vulnerable' development (basement dwellings, police, ambulance and fire stations and command centres, caravans – as defined by Annex 3: Flood risk vulnerability classification (**Table 6-1**)) in high surface water flood risk areas and / or Local Flood Risk Zones should be restricted and alternative sites sought, where possible. New self-contained basement dwellings (e.g., installation of bedrooms, bathrooms, or kitchens) should be restricted in areas where specific flood risk has been identified. 'Essential Infrastructure' associated with proposed developments may be discouraged from being placed on the ground floor in high flood risk areas.

6.3 Exception Test in Camden

6.3.1 The purpose of the Exception Test is to ensure that new development in flood risk areas will only occur where flood risk is clearly outweighed by other sustainability objectives and development will be safe and not increase flood risk elsewhere. In accordance with the NPPF and the incompatibility matrix presented in **Table 6-2**, the **Exception Test would *not* be required** in London Borough of Camden, as the Borough is located entirely within Flood Zone 1.

7. Site Specific Flood Risk Assessment Guidance

7.1 Guidance for Site Specific Flood Risk Assessment

Overview

7.1.1 This section outlines the requirements for when a site-specific Flood Risk Assessment is required for planning under the NPPF in addition to the requirements set out by Camden Council. Opportunities for flood risk management to mitigate flood risk to ensure a NPPF compliant Flood Risk Assessment is submitted are also described in **Section 7.2**.

7.1.2 As defined within the PPG, a site-specific Flood Risk Assessment is undertaken by, or on behalf of, a developer to assess flood risk to and from the proposed development. The site-specific Flood Risk Assessment should consider all sources of flood risk and demonstrate how risk will be managed now and in the development's lifetime, taking into account climate change and vulnerability of its users.

7.1.3 Footnote 55 of the NPPF states a site-specific Flood Risk Assessment is required in the following circumstances:

- In Flood Zone 2 and Flood Zone 3, including minor development and change of use;
- More than 1 hectare (ha) in Flood Zone 1;
- Less than 1 ha in Flood Zone 1 (including a change of use in development type to a more vulnerable class) where the development could be affected by sources of flooding other than rivers and sea;
- Land identified in a strategic flood risk assessment as being at increased flood risk in future; and
- In an area within Flood Zone 1 which has critical drainage problems, as notified by the Environment Agency.

7.1.4 The PPG states the objectives of a site-specific Flood Risk Assessment are to establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source;
- Whether the proposed development will increase flood risk elsewhere;
- Whether the measures proposed to deal with these effects and risks are appropriate;
- The evidence for the Local Planning Authority to apply (if necessary) the Sequential Test; and
- Whether the proposed development will be safe and pass the Exception Test (if applicable).

7.1.5 As the London Borough of Camden is located entirely within Flood Zone 1, no proposals located within Flood Zone 2 and 3 will be brought forward for development.

7.1.6 The site-specific Flood Risk Assessment should be proportionate to the degree of flood risk and make optimum use of the available information. The PPG provides a checklist for site-specific Flood Risk Assessment, which is presented in **Appendix E**. Where appropriate, references have been added to determine where the information can be found to support each required item.

7.1.7 In addition to the requirements of the NPPF, the Local Planning Authority have also developed more stringent requirements for when a Flood Risk Assessment is required within the Borough. This is described in **Section 6.2.10.**

Sequential Approach within Development Sites

7.1.8 The sequential approach should be applied *within* development sites to locate the most vulnerable elements of a development in the lowest risk areas. For example: residential developments should be restricted to areas at lower probability of flooding, including systems that are vulnerable to water ingress

such as air source heat pumps. Whereas parking, open space or proposed landscaped areas can be placed on lower ground with a higher probability of surface water flooding.

7.1.9 Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding.

7.1.10 Should development pressure create a need to develop more vulnerable land uses within the site in higher flood risk areas appropriate mitigation measures should be incorporated that are proportionate to the flood risk and would not increase the risk of flooding to surrounding areas.

7.1.11 Structures such as bus and bike shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground.

7.2 Flood Risk Management

7.2.1 This section assesses the potential opportunities and constraints associated with flood risk management measures within the context of the London Borough of Camden.

Emergency Planning

Flood Warnings

7.2.2 Flood warning and emergency procedures tend to form part of higher level emergency management plans for the wider area including information such as repair procedures, evacuation routes, refuge areas, flood warning dissemination and responsibilities.

7.2.3 No Environment Agency Flood Alerts or Warnings would be issued in the London Borough of Camden due to the absence of watercourses within the borough. Met Office Severe Weather Warnings provide warning to communities of extreme weather events, including rainfall events. This can be viewed at Met Office: UK Weather Warnings.

7.2.4 The Flood Warning Areas and Flood Alert Areas in proximity to the London Borough of Camden are presented in **Appendix A** (**Figure 28**).

Emergency Plan

7.2.5 As outlined in **Section 4.3**, Camden Council has developed a Multi-Agency Flood Plan to allow all responding parties to work together on an agreed coordinated response to severe flooding within the Borough. Where necessary, the Multi-Agency Flood Plan should be reviewed in the light of information generated by this SFRA and updated where appropriate. This will ensure that emergency plans are appropriate to the conditions expected during a flood event and that the local authority and emergency services are fully aware of the likely conditions and how this may affect their ability to safeguard the local population.

7.2.6 When submitting Flood Risk Assessments for developments within flood risk areas, developers should make reference to local weather warnings emergency procedures to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population. The flood hazard in a particular area must be viewed in the context of the potential evacuation and rescue routes to and from that area and discussed as part of a site-specific Flood Risk Assessment.

Property Flood Resilience

7.2.7 'Property Flood Resilience' is an approach to building design which aims to reduce flood damage and speed recovery and reoccupation following a flood. It uses a combination of flood resistance and recovery measures and is described in the industry-developed CIRIA Property Flood Resilience Code of Practice[92], which provides advice for both new-build and retrofit. It includes specific guidance for local authority planners.

[92] Kelly, D, Barker, M, Lamond, J, McKeown, S, Blundell, E and Suttie, E (2020) Guidance on the code of practice for property flood resilience, C790B, CIRIA, London (ISBN: 978-0-86017-895-8). [Online]. Available: https://www.ciria.org/CIRIA/Resources/Free_publications/CoP_for_PFR_resource.aspx [Accessed: 28/07/2023]

7.2.8 Resistance and recovery measures are unlikely to be suitable as the only mitigation measure to manage flood risk, but they may be suitable in some circumstances, such as:

- Water Compatible and Less Vulnerable uses where temporary disruption is acceptable and the development remains safe.
- Where the use of an existing building is to be changed and it can be demonstrated that the avoidance measures are not practicable, and the development remains safe.
- As a measure to manage residual flood risk from flood risk management infrastructure when avoidance measures have been exhausted.

7.2.9 Flood resistance and recovery measures cannot be used to justify development in inappropriate locations. However, they may be appropriate for consideration for existing buildings in areas prone to flooding.

7.2.10 Following the intense rainfall events of 1975, 2002 and 2021, parts of the London Borough of Camden suffered notable flooding associated with surface water and the local drainage network. Current climate change predictions suggest that intense rainfall events are likely to become more frequent, thereby putting a greater strain on the local drainage network and increasing the potential for surface water flooding. It is not possible for the drainage network to be upgraded to accommodate all extreme rainfall events and consequently there remains a risk that sewer and surface water flooding can occur. To mitigate the effects of flooding from these extreme events the homeowner or developer can install permanent or temporary flood proofing measures. This includes temporary and permanent flood barriers, in addition to non-return valves.

7.2.11 Temporary flood barriers are moveable flood defences that can be fitted to doorways or windows. On a smaller scale, temporary clip-on covers for airbricks and air vents can also be fitted to prevent water entry. Temporary flood barriers are generally less appropriate for properties at risk of surface water flooding, due to the flashy nature of these flood events. Permanent flood barriers are a more appropriate mitigation measure against surface water flooding. Permanent barriers may comprise built up doorsteps, rendered brick walls and toughened glass barriers. There are methods for ensuring that flood barriers are sympathetic to the surroundings.

7.2.12 In order to provide protection from the risk of sewer flooding, non-return valves can be installed to prevent water entering the property from drains and sewers. Further information can be found in the CIRIA publication 'Low cost options for preventing flooding from sewers'[93].

7.2.13 Where historic buildings are involved, early consultation with Historic England should be undertaken and their guide[94] on flood resilience for historic properties provides additional information. For example, solid timber doors are comparatively more water resistant compared to modern hollow doors, however it is understood that the flood depth from surface water flooding for lower ground properties may exceed the flood protection level offered by a timber door. As such, it may be acceptable for a composite door to be installed on the lower ground flood, as long as it is of similar appearance and justified due to flood risk.

7.2.14 The CIRIA Property Flood Resilience Code of Practice outlines the Water Exclusion Strategy and Water Entry Strategy, relating to the attempt to keep flood waters out of the property and to allow flood waters through a property to avoid structure damage, respectively.

Flood Resistance 'Water Exclusion Strategy'

7.2.15 Resistance measures are aimed at preventing water ingress into a building, to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration and for low depth flooding < 0.6 m. It is possible that structural damage could occur in traditional masonry construction due to excessive water pressures.

Flood Recovery 'Water Entry Strategy'

7.2.16 Flood recoverability measures (or wet-proofing), accept that water will enter the building, but through careful design and changes to the construction will minimise damage and allow faster cleaning, drying, repairing and re-occupancy of the building after a flood. Measures are preferably passive, such as the

[93] CIRIA, 1998, Low-cost options for prevention of flooding from sewers (C506)
[94] Historic England, Flooding and Historic Buildings (April 2015). [Online]. Available: https://historicengland.org.uk/images-books/publications/flooding-and-historic-buildings-2ednrev/ [Accessed: 28/07/2023]

use of resilient building materials, or active such as moving sensitive equipment or belongings to upper floors when flooding is expected.

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

7.2.18 A variety of flood recovery tools can be implemented, such as:

- Using materials with either, good drying and cleaning properties, or, sacrificial materials that can easily be replaced post-flood.
- Design for water to drain away after flooding.
- Design access to all spaces to permit drying and cleaning.
- Raise the level of electrical wiring, appliances, and utility metres.

Removal of Permitted Development Rights

7.2.19 Permitted development rights allow the improvement or extension of homes without the need to apply for planning permission, where that would be out of proportion with the impact of the works carried out[95]. Permitted development rights may be subject to prior approval by the Local Planning Authority due to risk of flooding[96]. Where prior approval is required, a site-specific Flood Risk Assessment must accompany the application in accordance with the NPPF[97] and the Town and Country Planning (General Permitted Development) (England) Order 2015[98].

7.2.20 Local Planning Authorities, such as Camden Council, could remove these rights (e.g. to prevent the development of front gardens) where it is necessary to protect local amenity or the well-being of the area, is based on robust evidence, and applies to the smallest geographical area possible.

Finished Floor Levels

7.2.21 There is no set guidance for the setting of finished floor levels of development in relation to flood risk other than from fluvial sources, where the Environment Agency requires a minimum freeboard of 300mm above the 1% AEP plus climate change peak fluvial flood level for More Vulnerable development such as housing.

7.2.22 In the absence of national guidance on finished floor levels, Camden Council should consider requiring a 300 mm freeboard above the predicted flood depths shown on the Risk of Flooding from Surface Water map during the 1 in 100 year event for proposed developments in areas of associated surface water flood risk.

Restrictions on Basements

7.2.23 A basement development is defined as a '*floor of a building which is partly or entirely below ground level*'. The Camden Authority Monitoring Report (2018 – 2021) published by Camden Council in 2023[99], indicates a decline in the number of approved basement applications. This follows the adoption of the

[95] GOV.UK, Guidance: Permitted development rights for householders – technical guidance [Online]. Available: https://www.gov.uk/government/publications/permitted-development-rights-for-householders-technical-guidance [Accessed: 08/06/2023]
[96] GOV.UK Ministry of Housing, Communities and Local Government & Department for Levelling Up, Housing and Communities, Guidance: Flood risk and coastal change (2022) [Online]. Available: https://www.gov.uk/guidance/flood-risk-and-coastal-change#para53 [Accessed: 08/06/2023]
[97] Department for Levelling Up, Housing and Communities, National Planning Policy Framework Paragraphs 152-173 (2012) [Online]. Available: https://www.gov.uk/guidance/national-planning-policy-framework/14-meeting-the-challenge-of-climate-change-flooding-and-coastal-change [Accessed: 08/06/2023]
[98] GOV.UK, The Town and Country Planning (General Permitted Development) (England) Order 2015. Available: https://www.legislation.gov.uk/uksi/2015/596/contents/made [Accessed: 08/06/2023]
[99] London Borough of Camden Council, Authority Monitoring Report (2023). Online. Available: https://www.camden.gov.uk/documents/20142/15882995/Camden+Authority+Monitoring+Report+2018-19+2019-20++2020-21.pdf/432dd24a-f397-83bb-4890-ba2fe0854d03?t=1677758172040 [Accessed: 29/09/2023]

Local Plan (2017) and tighter parameters on the size of basements that will be accepted, as outlined in **Table 7-1**.

Table 7-1: Number of Basement Applications Decided

Year	Total Number of Basement Applications		Percentage of Basement Applications	
	Granted	*Refused*	*Granted*	*Refused*
2015/16	103	13	89%	11%
2016/17	132	16	89%	11%
2017/18	96	13	88%	12%
2018/19	103	18	85%	15%
2019/20	63	13	83%	17%
2020/21	47	17	73%	27%

Groundwater Flooding

7.2.24 Factors influencing the risk of basement flooding include geological setting, thickness of the strata, depths to the water table and the permeability/confining nature of the layers. The creation of a barrier in the sub-surface may cause an obstruction to groundwater flow, which could lead to a rise in the water table on the upstream side and a fall in water table on the downstream side.

7.2.25 Groundwater flows within the River Terrace Deposits and Bagshot Formation would typically follow the course of 'lost' rivers, such as the River Fleet and River Tyburn[69]. Basement developments within proximity to a 'lost' river may be more susceptible to groundwater flooding, due to the culverting of the former river channel and subsequent impact on flow regimes and surrounding groundwater level.

7.2.26 As stipulated within the Camden Local Plan, a Basement Impact Assessment (BIA) is required to confirm the impact a basement dwelling may have to the surrounding land and how basements may be affected from sources of flooding. A rise and fall in the water table may occur as a result of a barrier in the sub-surface, which may cause an obstruction to groundwater flow. Additionally, wells and springs may be impacted by the basement developments due to redirection of groundwater flows. Larger basements will have a larger impact on the groundwater flow regime.

7.2.27 As detailed in **Section 5.3**, the northernmost and southernmost region of the London Borough of Camden is at risk of groundwater flooding as a result of the geology type which underlies the area. The greatest risk of groundwater flooding is posed to areas underlain by Bagshot Formation, Claygate Member and superficial deposits. The application process for basement schemes in these areas should be comprehensive and may require a site-specific Flood Risk Assessment.

7.2.28 Areas of the London Borough of Camden are underlain by unstable subsoils and historic watercourses, such as Hampstead Heath. In these areas, applications may require hydrological modelling to show whether inclusion of drainage systems can prevent harm and damage from changes to groundwater levels. The use of SuDS is encouraged for basements which extend beyond the profile of the existing building, encroach upon garden space and / or reduce the area of permeable surface on the site. SuDS will be required to mitigate any harm to the water environment.

7.2.29 Camden Planning Guidance on Basement Development was published by Camden Council in January 2021[100], to support policies outlined in the Camden Local Plan (**Section 4.3**). The guidance applies to all developments that propose a new basement or underground development, or an extension to an existing basement or other underground development. This includes ground floor development where excavation is required.

7.2.30 As per the Camden Planning Guidance on Basement Development, self-contained basement flats are not permitted in areas at risk of flooding. Basement schemes should not be permitted if the scheme includes bedrooms, bathrooms or kitchens, or other sensitive uses in areas prone to flooding. Applications for basement extension within flood risk areas will be expected to include a site-specific

[100] London Borough of Camden, Camden Planning Guidance – Basements January 2021 [Online]. Available: https://www.camden.gov.uk/documents/20142/4823269/Basements+CPG+Jan+2021.pdf/43eb1f08-dc6b-0aa5-4607-bcfbe4ba60e6?t=1611580510428 [Accessed: 08/06/2023]

Flood Risk Assessment. Install of a positive pumped device and / or a non-return valve is required for all basement and subterranean development.

7.2.31 For dwelling and non-dwelling basements, single storey accommodation and multi-storey buildings with ground floor sleeping accommodation in areas of flood risk from sources, external access should be located above the predicted flood level. For example, should the Risk of Flooding from Surface Water mapping indicate that a proposed development is in an area of medium or high flood risk, the level of external access should be of primary consideration. It should be noted that Risk of Flooding from Surface Water mapping should not be used on a site-specific basis due to the limitations of the modelling, but instead should be used as a guide for potential risk.

Surface Water Flooding

7.2.32 Basement dwellings may also be impacted if located on streets affected by surface water flooding. Basement dwellings are classified in the NPPF as a Highly Vulnerable development, therefore should be restricted within areas at high risk of surface water flooding. The Camden Planning Guidance (2021) states a basement development should not adversely affect drainage, run off or ground permeability.

7.2.33 Where basement dwellings are constructed, access must be situated 300 mm above the design flood level or if located within an area at low risk of flooding, 300 mm above the ground level. Waterproof construction techniques should be employed to avoid seepage during flood events. Similar problems can also occur where excessive surface water ponding occurs close to the sides of buildings, leading to significant infiltration. Surface water flow paths should be assessed to ensure that this does not occur, and to inform the strategic location of SuDS and techniques to route flows around the edge of buildings.

7.2.34 Camden Council should consider restricting the placement of sleeping accommodation below the external street level in areas of 'high' flood risk such as surface water in order to reduce the risk of water ingress into bedrooms during extreme rainfall events. For dwelling and non-dwelling basements, single storey accommodation and multi-storey buildings with ground floor sleeping accommodation in areas of flood risk from sources, external access should be located above the predicted flood level. For example, should the Risk of Flooding from Surface Water mapping indicate that a proposed development is in an area of medium or high flood risk, the level of external access should be of primary consideration. It should be noted that Risk of Flooding from Surface Water mapping should not be used on a site-specific basis due to the limitations of the modelling, but instead should be used as a guide for potential risk.

Sewer Infrastructure Flooding

7.2.35 Basements may be impacted by the surcharge of sewer infrastructure which would likely coincide with a high intensity rainfall event given Camden comprises a network of combined sewer networks. A review of Thames Water Utilities Limited DG5 records highlights postcode areas which have flooded as a result of sewer flooding. It is recommended that Basement Impact Assessments are undertaken for proposed developments within areas where >41 sewer flood incidents have been reported (**Figure 23**, **Appendix A**), and basements are restricted in areas at the highest risk of sewer flooding, such as those with a record of >60 incidents over the last 10 years (including postcode NW6 3, as presented in **Figure 23**, **Appendix A**).

Flood Routing

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

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

7.2.38 Possible opportunities to route overland flow paths include:

- Removing boundary walls or replacing with other boundary treatments such as hedges, post and rail fencing or hit and miss fencing (i.e., vertical slats fixed alternately on each side of horizontal posts),
- Considering alternatives to solid wooden gates or ensuring there is a gap beneath the gates to allow the passage of floodwater, and

- Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.

Safe Access and Egress

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

7.2.40 A safe access / egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances.

7.2.41 For surface water flooding, the design flood is a 1% AEP event, plus the appropriate allowance for climate change. Measures for safe access and egress should be modelled or testing using the design flood, to assess effectiveness.

7.2.42 For developments located in areas at flood risk the Environment Agency consider 'safe' access / egress to be in accordance with 'Flood Risk Assessment Guidance for new Developments FD 2320' (DEFRA and Environment Agency 2005)[101]. The requirements for safe access and egress from new developments are as follows in order of preference:

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

Sustainable Drainage Systems

7.2.43 When designing buildings, flood risk management policies require that the developments are 'safe', do not increase flood risk elsewhere and where possible reduce flood risk overall. Under the NPPF, major developments should incorporate SuDS unless there is clear evidence that it would be inappropriate. The systems should

- Account for advice from the Lead Local Flood Authority;
- Have appropriate proposed minimum operational standards;
- Have maintenance arrangements in place to ensure an acceptable standard of operation for lifetime of development; and
- Provide multifunctional benefits (where possible).

7.2.44 Schedule 3 of the Flood and Water Management Act (2010) is expected to be implemented in 2024. Under Schedule 3 of the Flood and Water Management Act (2010), construction work which has drainage implications may not be commenced unless a drainage system for the work has been approved by a SuDS Approval Body. The SuDS Approval Body can only grant applications that are compliant with national standards[102].

7.2.45 Major developments, which are defined as housing developments where 10 or more homes will be provided, or a site area of 0.5 ha or more[1], should not result in an increase in surface water runoff.

[101] Department for Environment, Food and Rural Affairs and Environment Agency, Flood Risk Assessment Guidance for New Development: Phase 2 Framework and Guidance for Assessing and Managing Flood Risk for New Development – Full Documentation and Tools (2005). [Online]. Available: https://assets.publishing.service.gov.uk/media/602d040fd3bf7f721a23a993/Flood_risk_assessment_guidance_for_new_development_-_phase_2_technical_report_Full_Documentation_and_Tools.pdf [Accessed: 21/07/2023]

[102] Department for Environment Food and Rural Affairs, The Review for Implementation of Schedule 3 to The Flood and Water Management Act 2010 (January 2023). [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1128073/The_review_for_implementation_of_Schedule_3_to_The_Flood_and_Water_Management_Act_2010.pdf [Accessed: 03/01/2024]

Where possible, the major developments must demonstrate betterment in terms of rate and volumes of surface water runoff. This is also encouraged for all scales of development.

7.2.46 It is strongly recommended that suitable surface water mitigation measures are incorporated into any development plans in order to reduce and manage surface water flood risk to and posed by the proposed development. This should be achieved by incorporating SuDS.

7.2.47 SuDS are typically softer engineering solutions inspired by natural drainage processes such as ponds and swales which manage water as close to its source as possible. Wherever possible, a SuDS technique should seek to contribute to each of the three goals identified below with the preferred system contributing significantly to each objective. Where possible SuDS solutions for a site should seek to:

- Reduce flood risk (to the site and neighbouring areas);
- Reduce pollution; and
- Provide landscape and wildlife benefits.

7.2.48 As outlined in the Interim Code of Practice for Sustainable Drainage Systems[103], these goals can be achieved by utilising a management plan incorporating a chain of techniques, where each component adds to the performance of the whole system; **Table 7-2** presents the SuDS Management Train.

Table 7-2: SuDS Management Train

Prevention	Good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping).
Source Control	Runoff control at/near to source (e.g. rainwater harvesting, green roofs, pervious pavements).
Site Control	Water management from a multitude of catchments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site).
Regional Control	Integrate runoff management systems from a number of sites (e.g. into a detention pond).

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

7.2.50 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.), which is of particular importance for mineral sites. Various SuDS techniques are available and operate on two main principles:

- Infiltration; and
- Attenuation.

7.2.51 All systems generally fall into one of these two categories, or a combination of the two. SuDS designs should aim to reduce runoff by integrating storm water controls throughout the site in small, discrete units. Through effective control of runoff at source, the need for large flow attenuation and flow control structures should be minimised.

7.2.52 Given how densely populated the London Borough of Camden is, space constraints for implementing swales and ponds will likely be limited and instead blue green roofs and attenuation tanks will be favoured. It is recommended that, where peak allowable discharge rate is calculated to be below 2 l/s, control for discharges from the site should be set to 2 l/s or have an orifice with a minimum diameter of

[103] National SuDS Working Group, Interim Code of Practice for Sustainable Drainage Systems (July 2004) [Online]. Available: https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf [Accessed: 08/05/2023]

50 mm[104]. This is to support self-cleansing velocity and minimise the build-up of sediment. In addition, access for maintenance must be considered early on in the design stage such as ensuring a 1.2 m diameter is provided at the last pipe in the sewer for man entry.

7.2.53 As part of any SuDS scheme, consideration should be given to the long-term maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. **Table 7-3** has been reproduced from the SuDS Manual, CIRIA C67953 and outlines typical SuDS options and details their typical components.

7.2.54 Catchment characteristics may impact the effectiveness of SuDS measures across the Borough, for example: a large proportion of the Borough is underlain by London Clay Formation which is typically characterised as impermeable. SuDS may be less effective in areas underlain by impermeable geology types as infiltration is impeded. Implementation of SuDS should therefore consider natural features which may impact SuDS, such geology.

Table 7-3: Typical SuDS Components

Component Description	Example
Filter Strips	Wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.
Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff and can infiltrate the water into the ground (if ground conditions allow).
Infiltration Basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.
Wetland Ponds	Wetland ponds are basins that can remove pollutants present within surface water. They provide runoff attenuation and wildlife benefits.
Extended Detention Basins	Extended detention basins are normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.
Constructed Wetlands	Constructed wetlands are ponds with shallow areas and wetland vegetation to improve pollutant removal and enhance wildlife habitat.
Filter Drains and Perforated Pipes	Filter drains are trenches that are filled with permeable material. Surface water from the edge of paved areas flows into the trenches, is filtered, and conveyed to other parts of the site. A slotted or perforated pipe may be built into the base of the trench to collect and convey the water.
Infiltration Devices	Infiltration devices temporarily store runoff from a development and allow it to percolate into the ground.
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g., toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing because, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.

SuDS Approval Body

7.2.55 Under Schedule 3 of the Flood and Water Management Act (2010), Camden Council is expected to be designated as the SuDS Approval Body for any new drainage system. This would require Camden Council to approve, adopt and maintain any new SuDS within the area. The SuDS Approval Body will have responsibility for the approval of proposed drainage systems in new developments and

[104] Department for Environment Food and Rural Affairs, Recommendations to Update Non-Statutory Technical Standards for Sustainable Drainage Systems (SuDS) – WT15122. [Online]. Available: https://randd.defra.gov.uk/ProjectDetails?ProjectID=20287&FromSearch=Y&Publisher=1&SearchText=WT15122&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description [Accessed:09/01/2024]

redevelopments, subject to exemptions and thresholds, and approval must be granted before the developer can commence construction.

7.2.56 The mandatory requirements for SuDS in England are yet to be implemented and in the interim period, the Lead Local Flood Authority is a statutory consultee to assess surface water drainage proposals for as part of the planning application process for major developments.

The SuDS Hierarchy

7.2.57 The National Standards for SuDS (2011)[105] states that *"the following destinations must be considered for surface runoff in order of preference:*

1. *Discharge into the ground;*
2. *Discharge to a surface water body;*
3. *Discharge to a surface water sewer; and*
4. *Discharge to a combined sewer."*

7.2.58 In addition to these standards, as outlined in **Section 4.3**, The London Plan (2021) provides further detail for Sustainable Drainage under Policy SI 13, following the principles of the National Standards. Development should "*aim to achieve greenfield runoff rates and ensure that surface water runoff is managed as close to its source as possible […] in line with the following drainage hierarchy:*

1. *Rainwater use as a resource;*
2. *Rainwater infiltration to ground at or close to source;*
3. *Rainwater attenuation in green infrastructure features for gradual release;*
4. *Rainwater discharge direct to a watercourse (unless not appropriate);*
5. *Controlled rainwater discharge to a surface water sewer or drain;*
6. *Controlled rainwater discharge to a combined sewer."*

Non-Statutory Standards

7.2.59 In March 2015, DEFRA published '*Sustainable Drainage Systems – Non-statutory technical standards for sustainable drainage systems*'[106], which outlines a set of standards that should be used in conjunction with the NPPF and PPG. Although non-statutory, it is advised that sustainable drainage systems are developed in line with the standards, to ensure drainage systems slow the rate of surface water runoff and improve infiltration through mimicking natural drainage processes. The technical standards are applicable to residential, non-residential, and mixed use developments, for the lifetime of the development. Application of the standards is intended to reduce the risk of 'flash flooding' occurring when rainwater rapidly flows into the sewer and drainage networks.

7.2.60 The document focuses upon peak flow control, volume control, flood risk within the development, structural integrity, maintenance, and construction. The key standards relevant to the London Borough of Camden are outlined below:

- *"S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event;*
- *S3 For developments which were previously developed, the peak runoff rate from the development […] for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same*

[105] DEFRA, National Standards for sustainable drainage systems: Designing, constructing, operating and maintaining drainage for surface runoff (December 2011) [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/82421/suds-consult-annexa-national-standards-111221.pdf [Accessed: 08/05/2023]

[106] DEFRA, Sustainable Drainage Systems – Non-statutory technical standards for sustainable drainage systems (2015). [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf [Accessed: 10/07/2023]

rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event;

- *S4 […] for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event;*
- *S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event;*
- *S6 Where it is not reasonably practicable to constrain the volume of runoff […], the runoff volume must be discharged at a rate that does not adversely affect flood risk;*
- *S7 The drainage system must be designed so that, […] flooding does not occur on any part of the site for a 1 in 30 year rainfall event;*
- *S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development; and*
- *S9 The design must ensure that, […] flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property."*

Feasibility of SuDS Hierarchy in the London Borough of Camden

Discharge into the Ground (Infiltration)

7.2.61 As discussed in **Section 5.3**, areas north of the London Borough of Camden are underlain by permeable bedrock, specifically Bagshot Formation and Claygate Member. The area is designated as a Secondary A aquifer, which can support local water supply and may form an important source of base flow to rivers. The capacity for infiltration and for storage at these locations suggests areas north of the Borough are potentially suitable for free-draining SuDS.

7.2.62 Whilst more preferable, the feasibility for free-draining SuDS in all other areas of the Borough is considered low, due to the impermeable London Clay Formation bedrock type.

7.2.63 Although areas south of the London Borough of Camden are underlain by permeable River Terrace Deposits, which would allow for infiltration in the upper strata, perched water bodies may form as a result of the underlying impermeable bedrock. Isolated perched water bodies could lead to slope instability, therefore flows from the free-draining SuDS could lead to issues associated with subsidence.

7.2.64 Ground investigation works to inform a site-specific Flood Risk Assessment are recommended to understand the feasibility of infiltration to the ground.

Discharge to Main Rivers and Ordinary Watercourses

7.2.65 All Main Rivers within the London Borough of Camden have been incorporated into the Thames Water Utilities Limited sewer network, there is no potential for new development to discharge to Main Rivers. There are no Ordinary Watercourses within the Borough, except for those located within Hampstead Heath. Hampstead Heath is protected under the Hampstead Heath Act 1971, which prohibits new development[107]. For this reason, there is no potential for discharge to an Ordinary Watercourse.

Discharge to a Surface Water Body

7.2.66 **Table 2-4** provides details of surface water bodies located within the London Borough of Camden ≥1500 m^2 in surface area, identified through aerial imagery. All surface water bodies above 1500 m^2 in surface area are located within Hampstead Heath and Waterlow Park, with the exception of the Regent's Canal. As such, there is limited potential for new development within the London Borough of Camden to discharge to a surface water body.

[107] GOV.UK, Hampstead Heath Act (1871). [Online]. Available: https://www.legislation.gov.uk/ukla/Vict/34-35/77/enacted [Accessed: 10/07/2023]

Discharge to a Surface Water Sewer

7.2.67 A limited number of surface water sewers are located with the London Borough of Camden; however, they all subsequently connect to a combined sewer. Therefore, any connection to a surface water sewer would increase flows to the combined sewer network. Opportunities for surface water attenuation and water re-use should be considered as part of any new development.

7.2.68 It is preferable to discharge to a surface water sewer only where possible, to alleviate pressure on the combined system which will convey surface water and foul water. As such, this minimises the risk of a sewer surcharge.

Discharge to a Combined Sewer

7.2.69 The London Borough of Camden is predominantly served by a combined sewer, which conveys surface water and foul water. New developments are most likely to discharge to the combined sewer due to the low potential to discharge into the ground, to a surface water body and as a result of the lack of Main Rivers and Ordinary Watercourses.

7.2.70 The NPPF states that new development must not increase surface water runoff rates post-development, and the London Plan states that all new development should aim to achieve greenfield runoff rates where practicable. Opportunities for surface water attenuation and water re-use, such as through use of water butts, should be considered as part of any new development.

7.2.71 For new developments, the developer and / or relevant party should confirm the capacity of the affected sewer and where connections are proposed to the existing sewers.

Working with Natural Processes

Potential and Constraints

7.2.72 Natural flood management involves techniques that aim to work with natural hydrological and morphological processes, features and characteristics to manage the sources and pathways of flood waters. Techniques include the restoration, enhancement and alteration of natural features and characteristics, but exclude traditional flood defence engineering that works against or disrupts these natural processes.

7.2.73 The contribution natural flood management techniques can make to reduce the causes and impacts of flooding will vary greatly. However, they contribute to the delivery of biodiversity and environmental net gains.

7.2.74 Given the urbanised nature of the Borough, there are limited opportunities available to reduce the causes and impact of flooding through Working with Natural Processes[108]. Defra have produced a Woodland Constraints dataset which refines potential locations for Working With Natural Processes, taking into account roads, rail, urban areas, existing woodland, peat, and water bodies. Primrose Hill to the south-west of the Borough has been identified as an opportunity for restoring woodland, as shown in **Appendix A** (**Figure 31**).

[108] Working With Natural Processes (WWNP) Evidence Directory [Online]. Available https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk [Accessed 01/08/2023]

8. Recommendations

8.1 Policy options

8.1.1 This section provides options for Camden Council to consider as part of the development of the Camden Local Plan. The policy options have been divided into five categories, on the basis of key flood risks and the potential opportunities for development specific to the Borough. The categories include: 'Spatial Planning', 'Flood Risk Management', 'Sustainable Drainage Systems and Surface Water Management' and 'Residual Risk and Emergency Planning'.

Spatial Planning

- Sites should be allocated in accordance with the Sequential Test to reduce the flood risk and ensure that the vulnerability classification of the proposed development is appropriate to the flood risk. Available information should be utilised to direct development towards areas of lowest flood risk, including the Environment Agency Risk of Flooding from Surface Water data, 'lost' rivers, susceptibility to groundwater flooding data, Local Flood Risk Zone, Camden Council records of Previously Flooded Streets and sewer flood incidents (DG5 Records). Given the risk of flooding from a reservoir breach is considered unlikely, as agreed with Camden Council, this dataset has not informed the Sequential Test. Where sites are situated within the predicted extent of a reservoir breach, it is recommended that an Emergency Plan is produced.
- Basement dwellings and other 'Highly Vulnerable' development (**Table 6-1**) should be restricted in areas at high flood risk such as Local Flood Risk Zone and locations where a 'high' surface water flood risk has been identified, which is defined as areas at risk of >3.33% AEP event. The Susceptibility to Groundwater Flooding data and areas underlain by 'lost' rivers should also be considered, to identify locations where basement structures are likely to affect groundwater flows through diversion and changes to the water table;
- Basement schemes which include habitable rooms and other sensitive uses for self-contained basement flats and other underground structures in areas prone to flooding should not be permitted; and
- A proportion of the London Borough of Camden is located within the Counters Creek Catchment, which is hydraulically connected to Boroughs located in the downstream catchment area. As identified within this SFRA, there is potential for new developments in the upstream area of the Counters Creek Catchment to affect areas downstream in the catchment. As such, the impact of new development on flood risk beyond the London Borough of Camden boundaries should continue to be examined as part of an integrated, collaborative approach to managing flood risk.

Flood Risk Management

Site-Specific Flood Risk Assessment

- The entire London Borough of Camden is located within Flood Zone 1, which comprises land outside the extent of fluvial and sea flooding in a 0.1% AEP event. As set out in the NPPF all types of development are considered appropriate within Flood Zone 1. However, proposals for new development greater than 1 hectare in Flood Zone 1 will require a site-specific Flood Risk Assessment to assess the risk of flooding from all sources and demonstrate that the proposed development will not increase flood risk elsewhere. This will require information on how surface water generated by the site will be managed in a sustainable manner.
- Within the Borough, site-specific Flood Risk Assessments are required for:
  - Sites of 1 ha or greater;
  - All applications where flood risk has been identified in accordance with criteria (as outlined within this SFRA – see below); and
  - All basement development, where flood risk has been identified in accordance with criteria (as outlined within this SFRA – see below).

- Camden Council should consider requiring a Flood Risk Assessment to accompany all developments located within a Local Flood Risk Zone, Previously Flooded Street, a DG5 Sewer Flooding Postcode with 41 + incidents and/or within the extent of medium or high surface water flood risk area.
- All basements developments will require a Flood Risk Assessment if located within a Local Flood Risk Zone, Previously Flooded Street, a DG5 Sewer Flooding Postcode with 21+ incidents, an area underlain by a 'lost' river, within the extent of a medium or high surface water flood risk area and/or in an area categorised as 'potential for groundwater flooding to occur at the surface'.
- Surface water flooding should be investigated in detail as part of a site-specific Flood Risk Assessment for future developments and early liaison with Camden Council as the Lead Local Flood Authority is recommended for appropriate management techniques.
- Groundwater flooding should be investigated in more detail as part of site-specific Flood Risk Assessments for developments located in areas of the borough where there is a potential for groundwater flooding to occur at the surface; see **Appendix A** (**Figure 19**).

Local Critical Drainage Areas, Local Flood Risk Zones and Previously Flooded Streets

- Whilst the NPPF does not stipulate specific policy requirements relating to Local Critical Drainage Areas, Local Flood Risk Zones, and Previously Flooded Streets, it is recommended that these are considered to allow appropriate mitigation measures to be implemented for new development in the London Borough of Camden. Most of Camden is located within a series of Local Critical Drainage Areas (as defined within the Surface Water Management Plan under **Section 4.3**). No areas have been identified by the Environment Agency as having critical drainage problems. All opportunities should be taken during development to reduce existing runoff rates post-development. Where this is not possible, the rates should be as close as possible to greenfield runoff rates and should not exceed those of pre-development[109]. Camden Council should consider setting as a requirement a minimum reduction in surface water runoff post-development (i.e. reducing to greenfield runoff rates).
- As outlined in the NPPF, where changes of use result in an increase in the vulnerability classification of a development, applicants should be required to provide an assessment of flood risk to accompany their planning application. This should demonstrate how the flood risks to the development will be managed so that it remains safe through its lifetime including provision of safe access and egress. For proposed developments within a Local Flood Risk Zone, Previously Flooded Street or DG5 Sewer Record (60+) a Flood Risk Assessment should be undertaken to assess the flood risk to and from the development for all sources of flooding.
- For proposed developments located on a Previously Flooded Street, as presented within **Appendix A** (**Figure 4**), Camden Council should consider setting as a requirement a minimum reduction in surface water runoff rates post-development to greenfield runoff rates The intention of such a requirement would be to reduce surface water runoff and also reduce the strain on the combined sewer network.
- When re-developing existing buildings in areas at risk from flooding, especially when identified on a Previously Flooded Street, the use of flood resilient measures should be promoted at the individual property level. Measures introduced for basement dwellings may need to be more robust, to protect from potential groundwater flood risk. Measures could include non-return valves.

Counters Creek Catchment

- Consideration should be made of the impact of development in the Counters Creek Catchment on sewer capacity in the London Borough of Camden and neighbouring areas, including the Borough of Brent, Royal Borough of Kensington and Chelsea and City of Westminster. Restricting to greenfield runoff as a minimum is strongly recommended to reduce the potential risk of surface water flooding within the Counters Creek Catchment.

[109] DEFRA, Sustainable drainage systems – non-statutory technical standards for sustainable drainage systems (2015). [Online]. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf [Accessed: 05/05/2023]

Basement Impact Assessment

- The screening stage of a Basement Impact Assessment should be applied to all basement developments to identify any potential risks in relation to the water environment or local properties. Should any risks be identified, appropriate assessment of these risks should be carried out. A Basement Impact Assessment should demonstrate that the impacts of the proposed development are acceptable, or that appropriate mitigation measures will be adopted.

Sustainable Drainage Systems and Surface Water Management

- NPPF requires the use of SuDS as an opportunity for managing flood risk, improving water quality, and increasing amenity and biodiversity. All development must include permeable surfaces, incorporating green and blue roofs, and seek to replace non-permeable surfaces where feasible. Proposals including impermeable surfacing will be resisted unless it can be demonstrated to the Council's satisfaction that this is unavoidable.
- The Council will require a drainage report to be submitted with all major applications, basement developments and other vulnerable development in areas identified at risk of flooding (see Camden Planning Guidance Basements for further guidance).
- SuDS should be included in new developments unless it is demonstrably not possible to manage surface water using these techniques. **Section 8.1** should be consulted in the first instance for guidance on the potential for SuDS techniques. It is assumed that the central and southern region of the London Borough of Camden is likely to suffer significant constraints associated with infiltration SuDS. These techniques will be least constrained in the north of the Borough where it is underlain by the Bagshot Formation **Appendix A** (**Figure 12**).
- Policy CC3 of the London Borough of Camden Local Plan states development should aim to achieve greenfield runoff rates, and where this is not possible, runoff rates post-development should not exceed those pre-development, as per the NPPF. In addition, an allowance should be made for climate change. **Section 4.5** should be consulted for the appropriate allowance.
- Potential overland flow paths should be considered to ensure that buildings do not obstruct flows.
- Where basements are proposed the risk of surface water and groundwater flooding should be considered, with possible mitigation options including raised thresholds, dry proofing and inclusion of storage for surface water in such developments.
- Opportunities should be sought to reduce the risk of flooding from the sewer network through consultation with Thames Water Utilities Limited to determine key areas for maintenance and flood alleviation schemes.
- Proposed developments within areas which have previously been affected by sewer flooding (as illustrated in **Appendix A** (**Figure 23**) should seek advice from Thames Water Utilities Limited to manage flood risk.
- The vulnerability and importance of local ecological resources, such as water quality and biodiversity, should be considered when determining the suitability of SuDS.

Residual Risk and Emergency Planning

- Where development within flood risk areas is absolutely necessary, flood proof construction methods should be employed to reduce the impact of flooding.
- Where development is within flood risk areas, emergency planning strategies should be put in place in order to direct people to safety during times of flooding.

8.2 Potential Opportunities

- Policy A2 of the London Borough of Camden Local Plan (2017) states opportunities should be sought to enhance links between open space and the multiple benefits offered from small-scale measures, such as SuDS. These should be introduced to the areas of open space within the Borough. Implementation of SuDS on a large scale would improve attenuation of flows and help to protect these spaces in the long term.

- Under Policy A3 of the Camden's Local Plan, Camden Council will seek to protect and secure additional trees and vegetation. Developments are expected to incorporate trees and vegetation wherever possible. This could be of benefit to flood risk, through interception of surface water pathways and subsequent reduction in surface water flows, helping to alleviate pressure on sewer systems.

8.3 Next Steps

8.3.1 Camden Council should use this SFRA, the associated mapping and resulting recommendations to:

- Develop their Local Plan and associated strategic policies,
- Safeguard land for blue-green infrastructure,
- Carry out the sequential test for potential allocation sites,
- Make decisions about individual planning applications,
- Decide whether a development can be made safe without increasing flood risk elsewhere,
- Identify the need for local design guidance or codes,
- Aid discussions with emergency planning teams.

8.4 Living Document

8.4.1 This SFRA will be updated in the future, to reflect local evidence of flooding and to account for changes in policy and planning guidance. Updates to the document will be dependent on the publication and acceptance of relevant documentation and information, such as Section 19 Flood Investigation Reports and flood incident records.

8.4.2 The Environment Agency review and update the Flood Map for Planning (Rivers and Sea) on a quarterly basis. The Risk of Flooding from Surface Water mapping is updated on an ad-hoc basis. As such, new flood risk data may influence the allocation of future development. Therefore, it is important that the SFRA is reviewed and updated in line with flood risk datasets, to improve understanding of flood risk areas within the Local Planning Authority area.

Appendix A Figures

Figure 3: Study Area and Notable Locations

Figure 4: Previously Flooded Streets (1975, 2002 & 2021)

Figure 5: Previously Flooded Streets (1975)

Figure 6: Previously Flooded Streets (2002)

Figure 7: Previously Flooded Streets (2021)

Figure 8: LiDAR Digital Terrain Model (2m)

Figure 9: Main Rivers and Ordinary Watercourses

Figure 10: Environment Agency Historical Flood Extent

Figure 11: Historic Map (1805-1874) and 'Lost' Rivers - Emapsite

Figure 12: Bedrock Geology

Figure 13: Superficial Geology

Figure 14: Flood Map for Planning

Figure 15: Risk of Flooding from Surface Water

Figure 16: Local Critical Drainage Areas and Local Flood Risk Zones

Figure 17: Counters Creek Catchment – External Flood Risk

Figure 18: Counters Creek Catchment - Internal Flood Risk

Figure 19: Susceptibility to Groundwater Flooding

Figure 20: Aquifer Designation

Figure 21: Source Protection Zones

Figure 22: Thames Water Sewer Mapping

Figure 23: Thames Water DG5 Records

Figure 24: Flood Risk from Reservoirs – Wet Day

Figure 25: Flood Risk from Reservoirs - Dry Day

Figure 26: EA Flood Defences and AIMS Structures

Figure 27: Reduction in flood risk from Rivers and Sea due to Defences

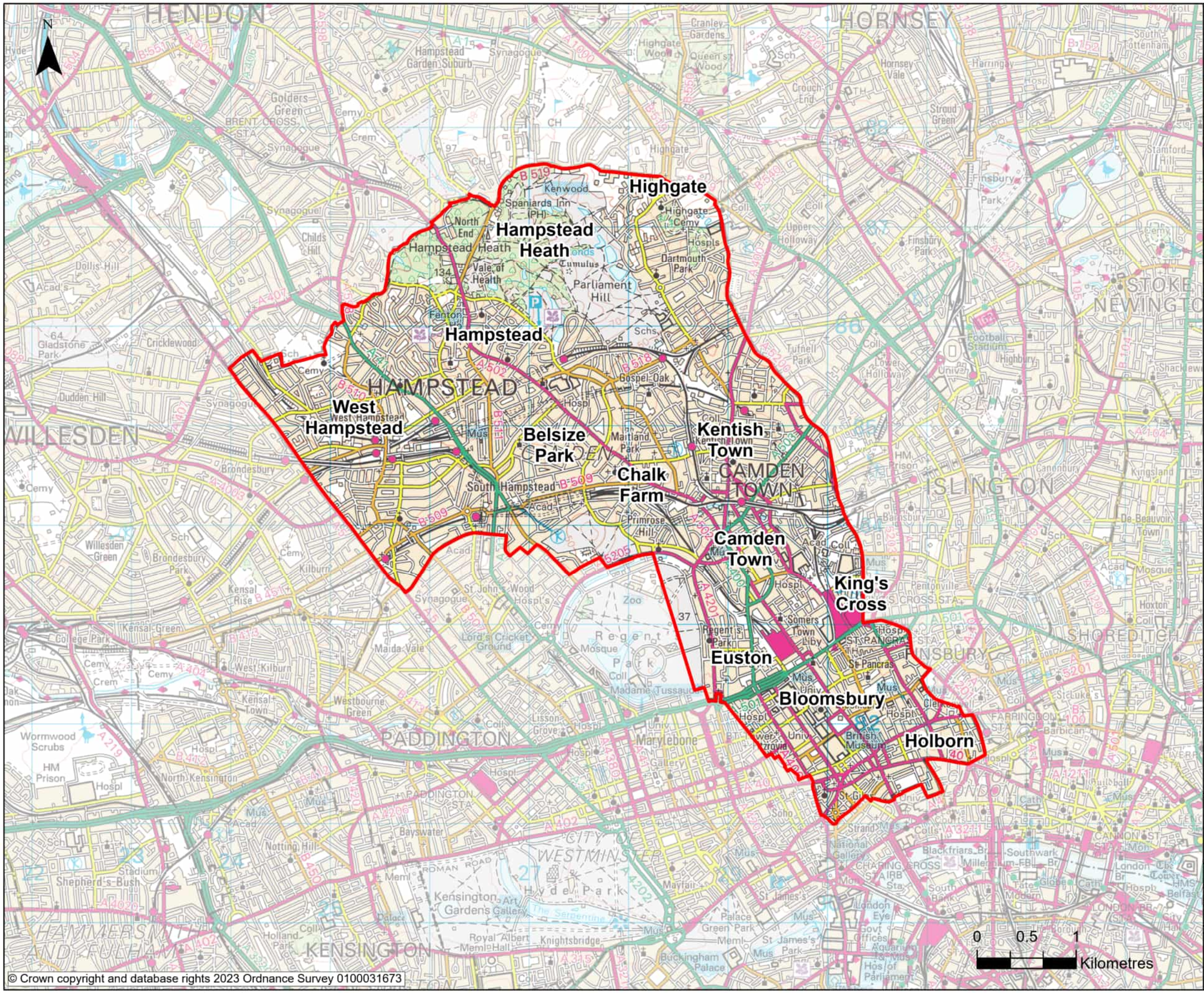
Figure 28: Existing Flood Alert and Flood Warning Areas

Figure 29: Detailed Defended Hydraulic Model Outputs (1 in 100 Year + Climate Change) – Environment Agency (River Lee 2014, River Brent 2014, Silk Stream 2019)

Figure 30: River Thames Tidal Breach Assessment (Maximum Flood Extents) – Environment Agency 2017

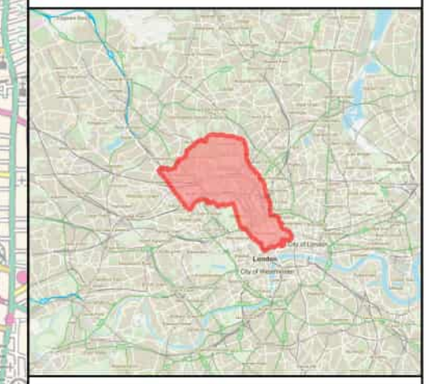
Figure 31: Working With Natural Processes - Potential and Constraints

Figure 32: Section 19 Flood Investigation Report – Focus Areas



Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

London Borough of Camden

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: London Borough of Camden: Notable Locations

Client: Camden

Scale at A3: 1:37,000

Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

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Figure: 3

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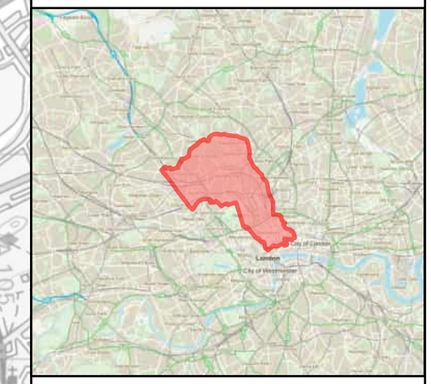
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Flooded Streets (2021)
- Flooded Streets (2002)
- Flooded Streets (1975)

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Flooded Streets 1975, 2002 & 2021

Client: Camden

Scale at A3: 1:30,000

Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

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Figure: 4

0 0.5 1 Kilometres

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Job Title

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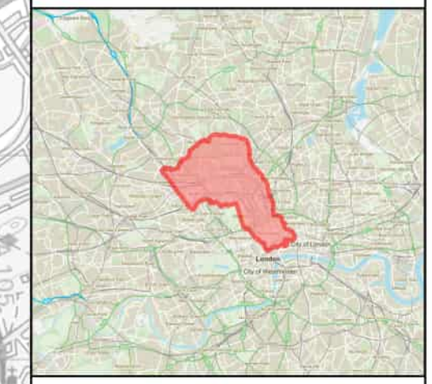

Legend

- London Borough of Camden
- Flooded Streets (1975)

0 0.5 1 Kilometres

Attributed to London Borough of Camden Council

Notes	This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.
Drawing Status	FINAL
Drawing Title	Flooded Streets 1975
Client	Camden
Scale at A3	1:30,000
Drawn	RR
Checker	HW
Approver	SL
Date	10/01/2024
AECOM	AECOM 4th Floor 100 Embankment Manchester M3 7FB Tel: 0161 601 1700
Project Number	60701446
Figure	5

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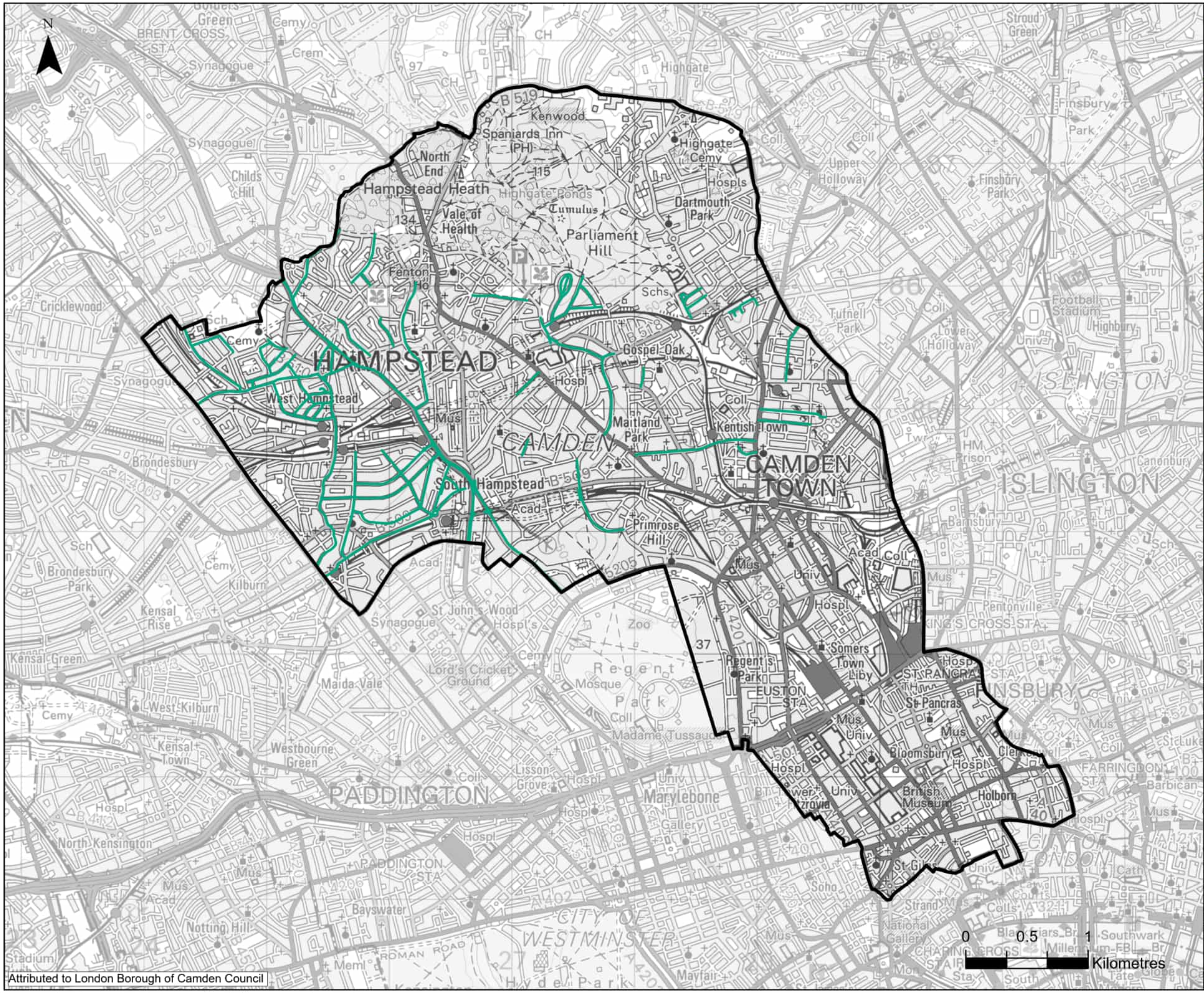
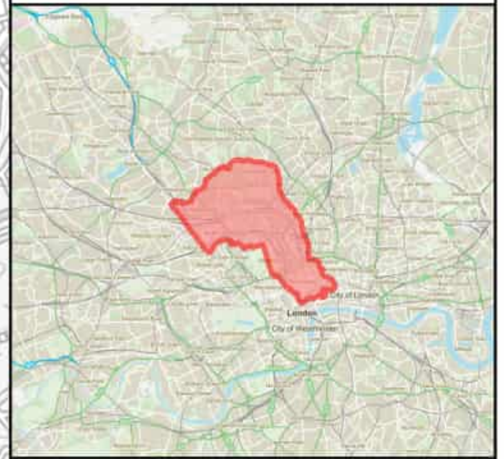


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Flooded Streets (2002)

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Flooded Streets 2002

Client: Camden

Scale at A3: 1:30,000

Drawn: RR | Checker: HW

Approver: SL | Date: 10/01/2024

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Project Number: 60701446

Figure: 6

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Job Title

London Borough of Camden
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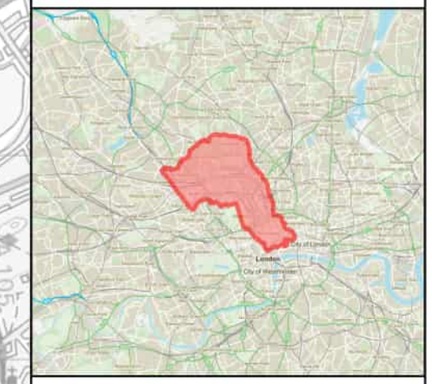
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Flooded Streets (2021)

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Flooded Streets 2021

Client: Camden

Scale at A3: 1:30,000

Drawn: RR | Checker: HW

Approver: SL | Date: 10/01/2024

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Figure: 7

0 0.5 1 Kilometres

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Job Title

London Borough of Camden
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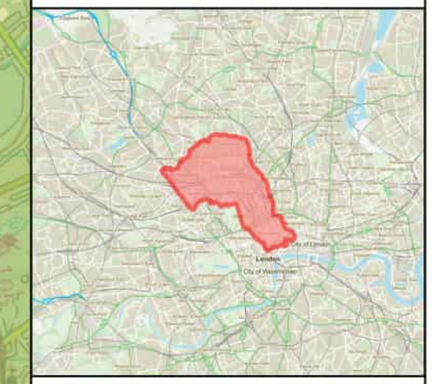
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

LiDAR DTM (2m)

mAOD

- -42 - 14
- 15 - 33
- 34 - 55
- 56 - 80
- 81 - 137

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: LiDAR Imagery
Digital Terrain Model 2m

Client: Camden

Scale at A3: 1:30,000

Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

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Figure: 8

0 0.5 1 Kilometres

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River Brent
Main River

River Lea
Main River

Ironstone

Regent's
Canal

Regent's
Canal

River Thames
Main River

HENDON
HORNSEY
HAMPSTEAD
CAMDEN
CAMDEN
TOWN
ISLINGTON
WILLESDEN
PADDINGTON
CITY OF
WESTMINSTER
KENSINGTON
HAMMERSMITH
AND FULHAM
STOKE
NEWINGTON
SHOREDITCH
FINSBURY

0 0.5 1
Kilometres

Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment

Legend

- London Borough of Camden
- Main River
- Ordinary Watercourses

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use

Drawing Status: FINAL

Drawing Title: Main River and Watercourses

Client: Camden

Scale at A3: 1:37,000

Drawn: RR | Checker: HW

Approver: SL | Date: 10/01/2024

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Figure: 9

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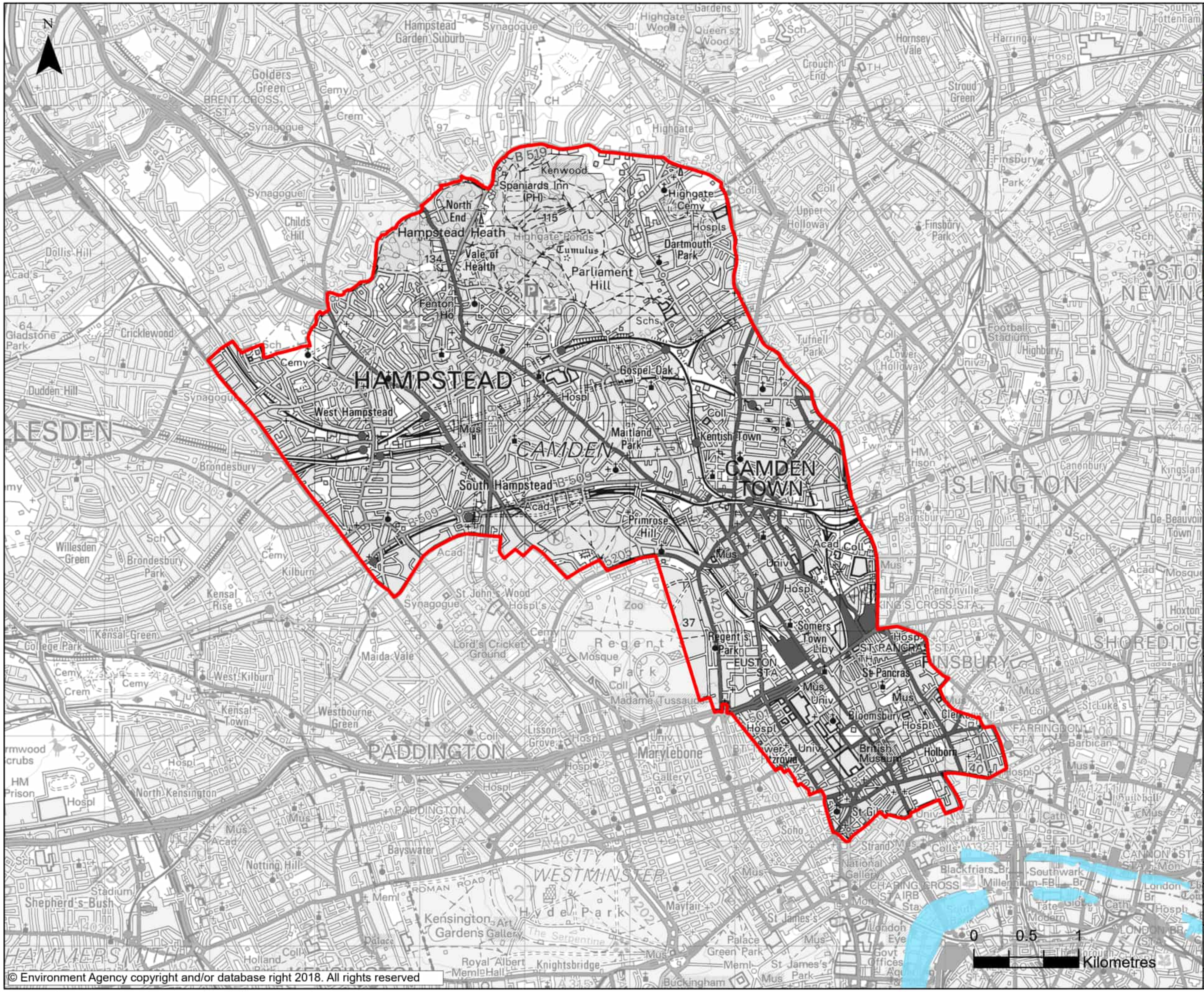
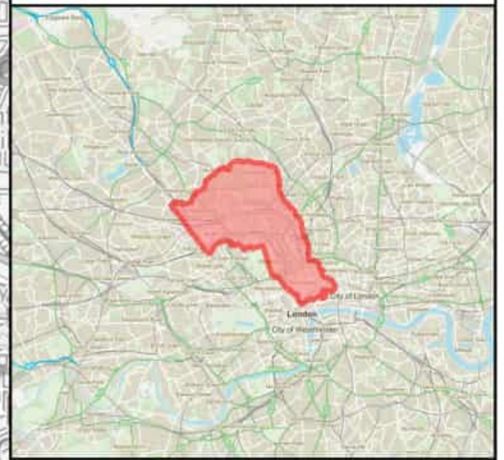
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment





Legend

- London Borough of Camden
- Environment Agency - Historic Flood Map Extent

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Environment Agency - Historic Flood Map

Client: Camden

Scale at A3: 1:35,000

Drawn: RR | Checker: HW

Approver: SL | Date: 10/01/2024

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Project Number: 60701446 | Figure: 10

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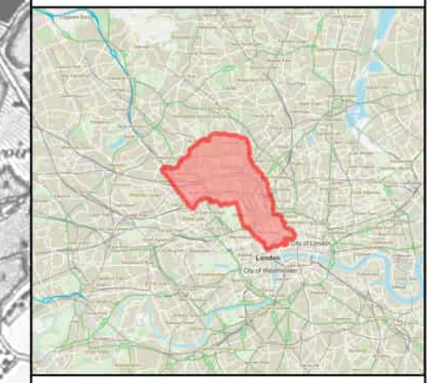
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Historic Watercourse

- River Fleet
- River Tyburn
- River Westbourne

River Westbourne

River Tyburn

River Fleet

0 0.5 1 Kilometres

Notes	This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.
Drawing Status	FINAL
Drawing Title	Historic Map 1805-1874
Client	Camden
Scale at A3	1:30,000
Drawn	RR
Checker	HW
Approver	SL
Date	10/01/2024
AECOM	AECOM 4th Floor 100 Embankment Manchester M3 7FB Tel: 0161 601 1700
Project Number	60701446
Figure	11

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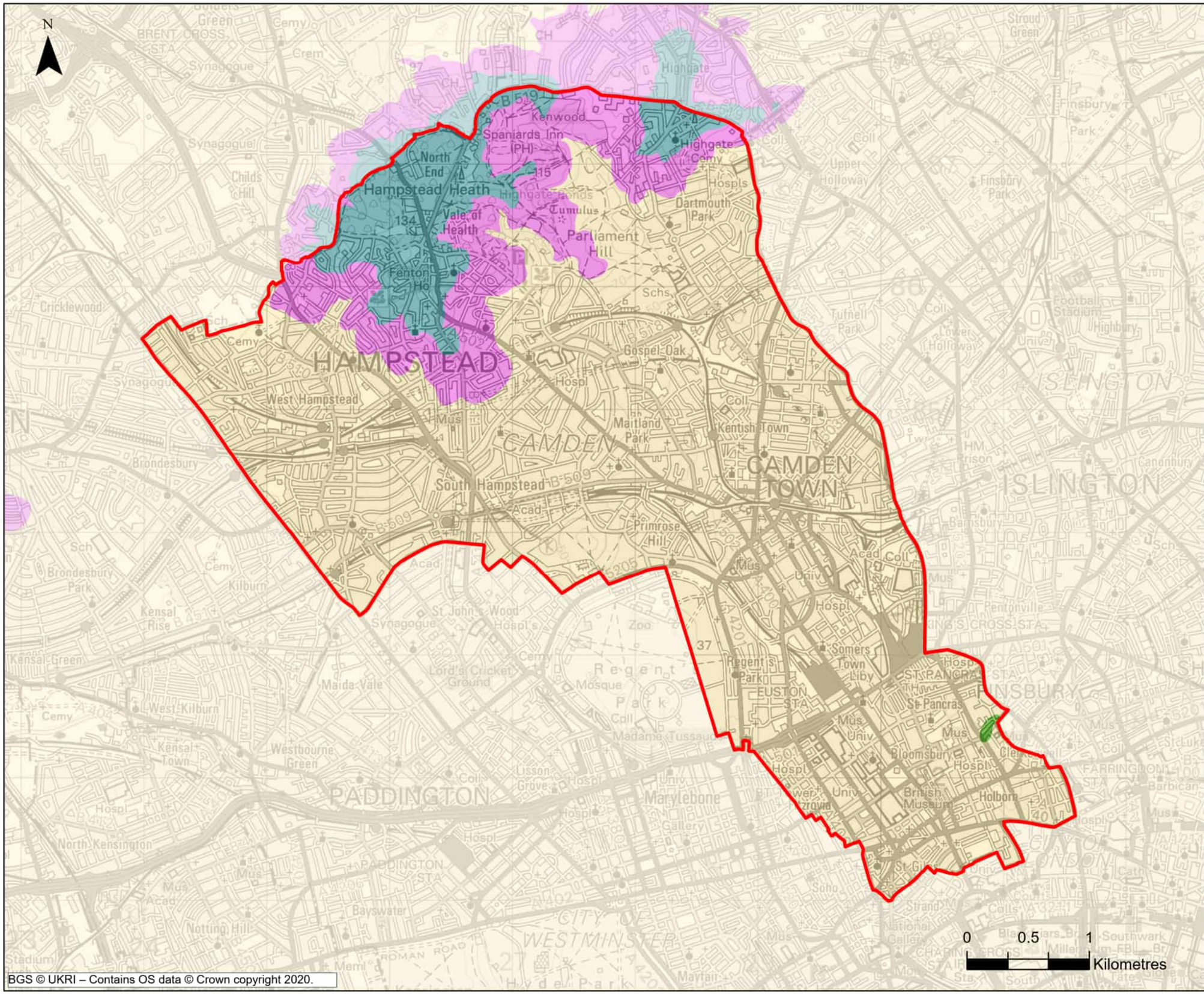
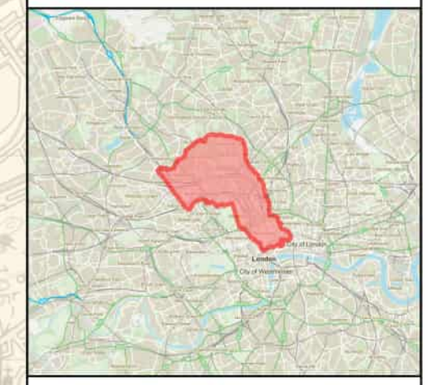


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Bedrock Geology

- Bagshot Formation
- Claygate Member
- Lambeth Group
- London Clay Formation

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Bedrock Geology

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Tel: 0161 601 1700

Project Number: 60701446

Figure: 12

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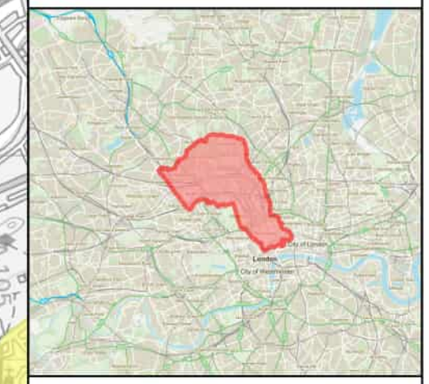
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Superficial Deposits Not Present

Superficial Deposits Not Present

Legend

- London Borough of Camden

Superficial Geology

- Alluvium
- Boyn Hill Gravel Member
- Dollis Hill Gravel Member
- Finsbury Gravel Member
- Hackney Gravel Member
- Kempton Park Gravel Formation
- Langley Silt Member
- Lynch Hill Gravel Member
- Stanmore Gravel Formation
- Taplow Gravel Formation
- Superficial Deposits Not Present

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Superficial Geology

Client: Camden

Scale at A3: 1:30,000

Drawn	Checker
RR	HW
Approver	Date
SL	10/01/2024

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Manchester
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Project Number: 60701446

Figure: 13

0 0.5 1 Kilometres

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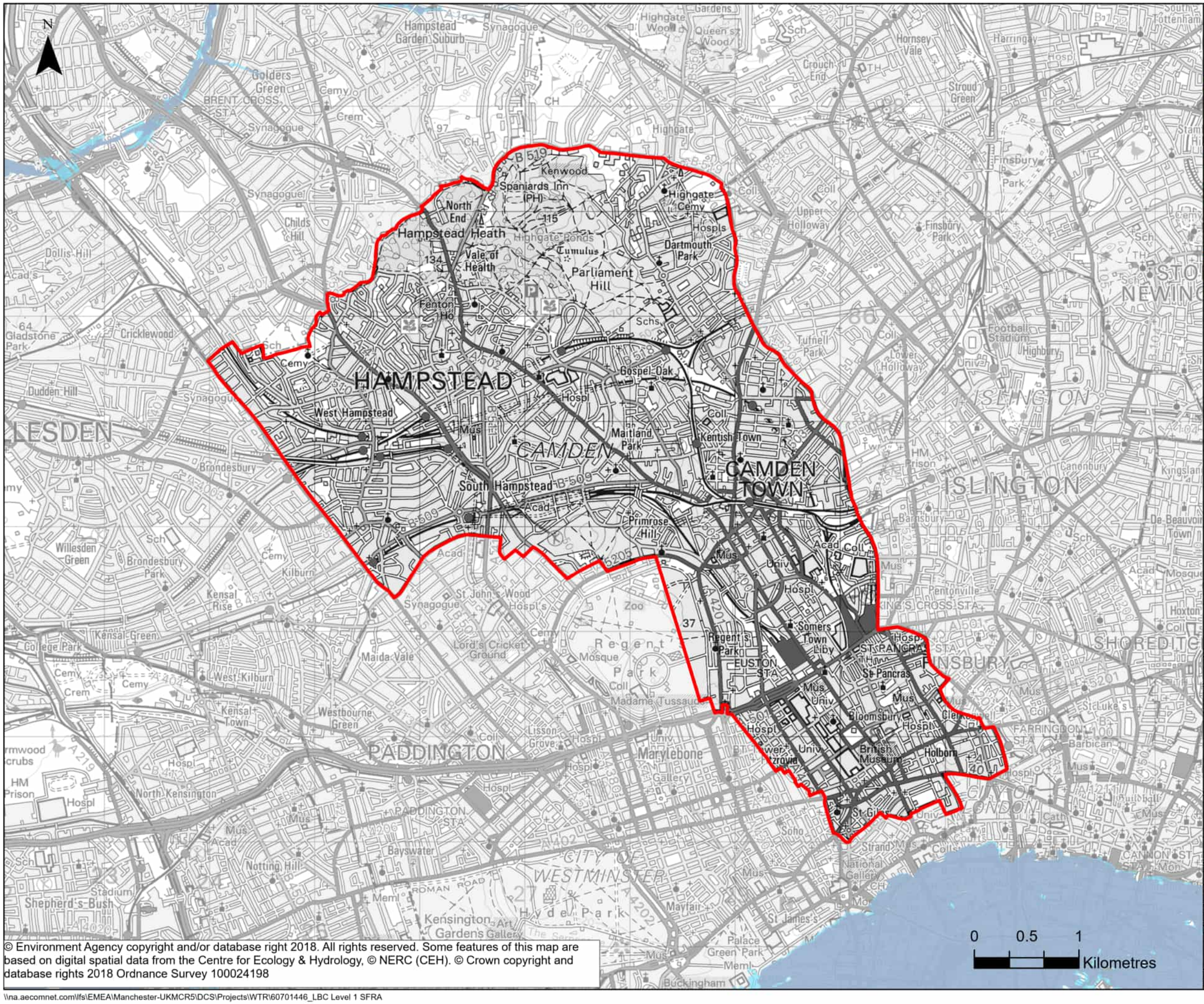
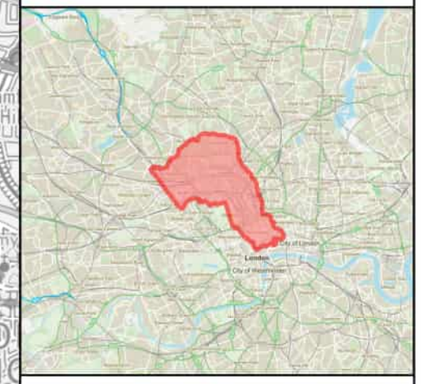


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Flood Zone 3
- Flood Zone 2

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Flood Map for Planning

Client: Camden

Scale at A3	1:35,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 14

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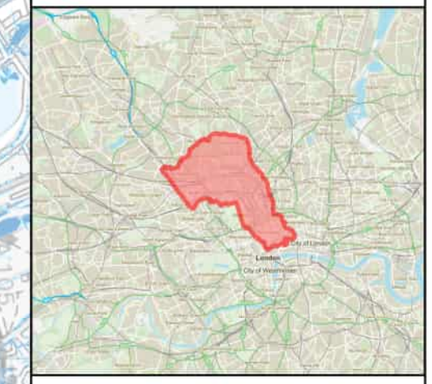
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- High Risk (≥3.33% AEP event)
- Medium Risk (1% - 3.33% AEP event)
- Low Risk (0.1% - 1% AEP event)

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use

Drawing Status: FINAL

Drawing Title: Risk of Flooding from Surface Water

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 15

0 0.5 1 Kilometres

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N

Group3_001

Group3_002

Group3_003

Group3_004

Group3_005

Group3_006

Group3_007

Group3_010

Group3_011

York Rise

South End

Frognal Lane

Cannon Hill

Gospel Oak

Maitland Park

Sumatra Road

Goldhurst

Kingsgate

Priory

Primrose Hill

King's Cross

North Swinton Street

South East Regent's Park

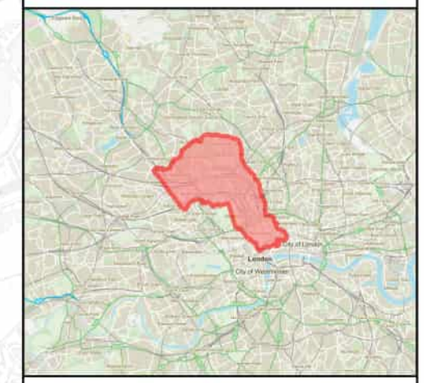
Farringdon

0 0.5 1 Kilometres

Attributed to London Borough of Camden Council

Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Local Flood Risk Zone
- New Local Flood Risk Zone
- Local Critical Drainage Area

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Critical Drainage Areas and Local Flood Risk Zones

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 16

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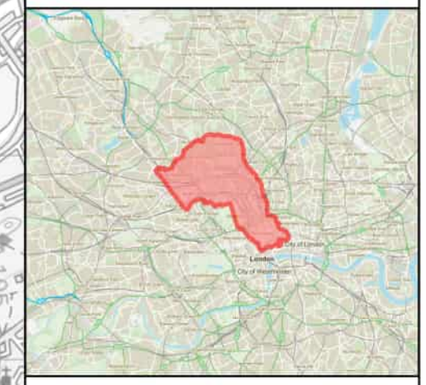
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Counters Creek Catchment
- Indicative Area of Potential External Flooding

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Counters Creek Catchment

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 17

0 0.5 1 Kilometres

Attributed to London Borough of Camden Council and Thames Water

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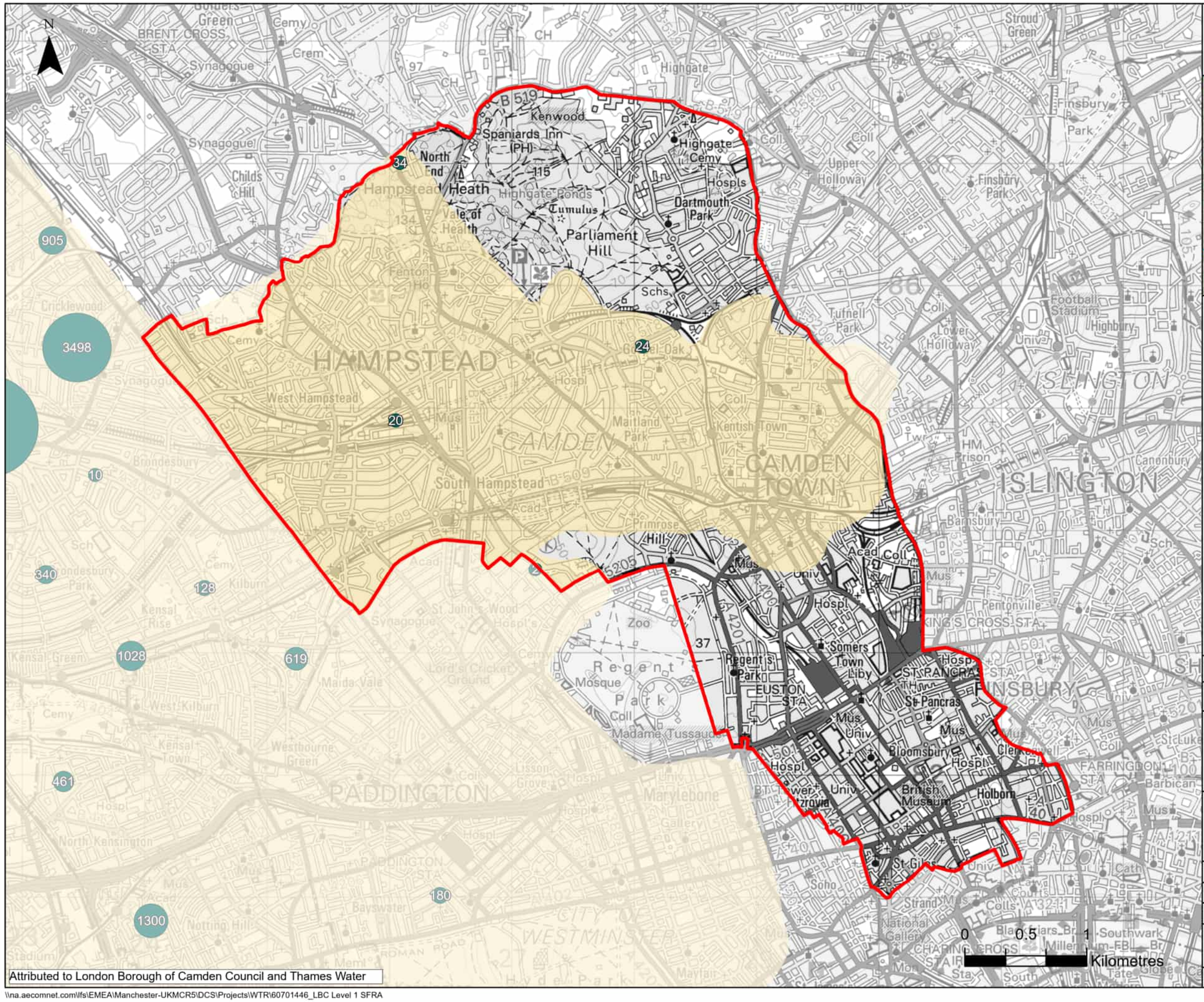
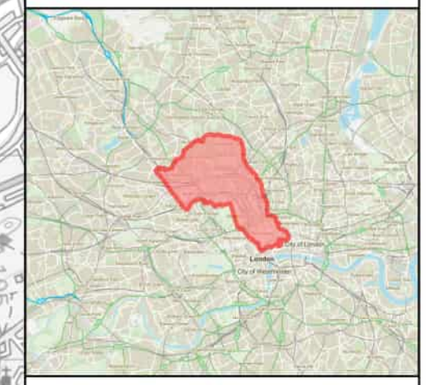


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Counters Creek Catchment
- Indicative Area of Potential Internal Flooding

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Counters Creek Catchment

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 18

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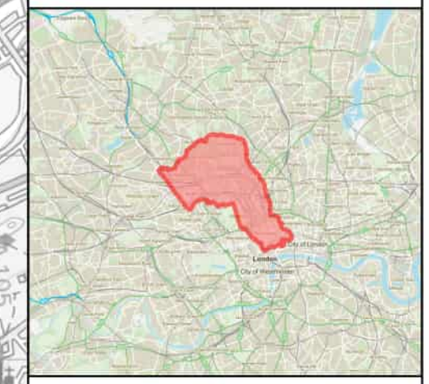
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Suceptibility to Groundwater Flooding

- Limited potential for groundwater flooding to occur
- Potential for groundwater flooding of property situated below ground level
- Potential for groundwater flooding to occur at surface

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status	FINAL
Drawing Title	Susceptibility to Groundwater Flooding
Client	Camden
Scale at A3	1:30,000
Drawn	RR
Checker	HW
Approver	SL
Date	10/01/2024
Project Number	60701446
Figure	19

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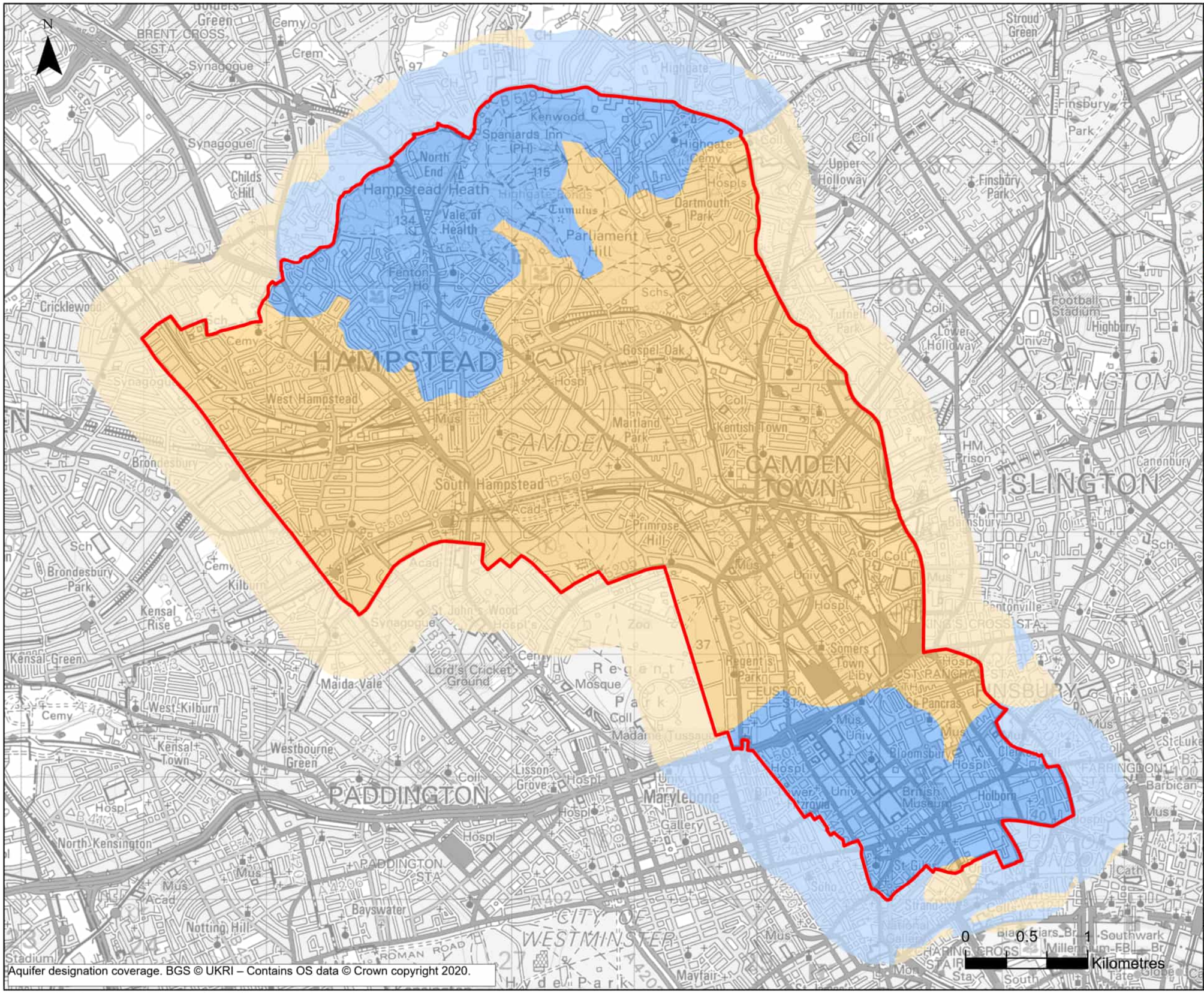
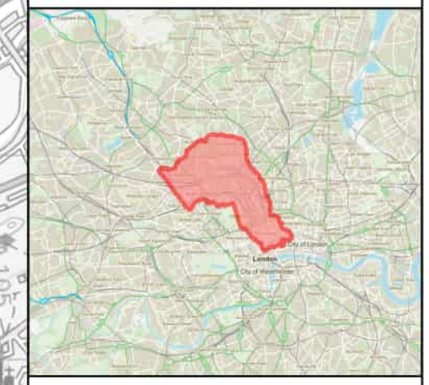
Tel: 0161 601 1700

0 0.5 1 Kilometres



Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Aquifer Designation

- Secondary A
- Unproductive

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Aquifer Designation

Client: Camden

Scale at A3	1:30,000		
Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

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Project Number: 60701446

Figure: 20

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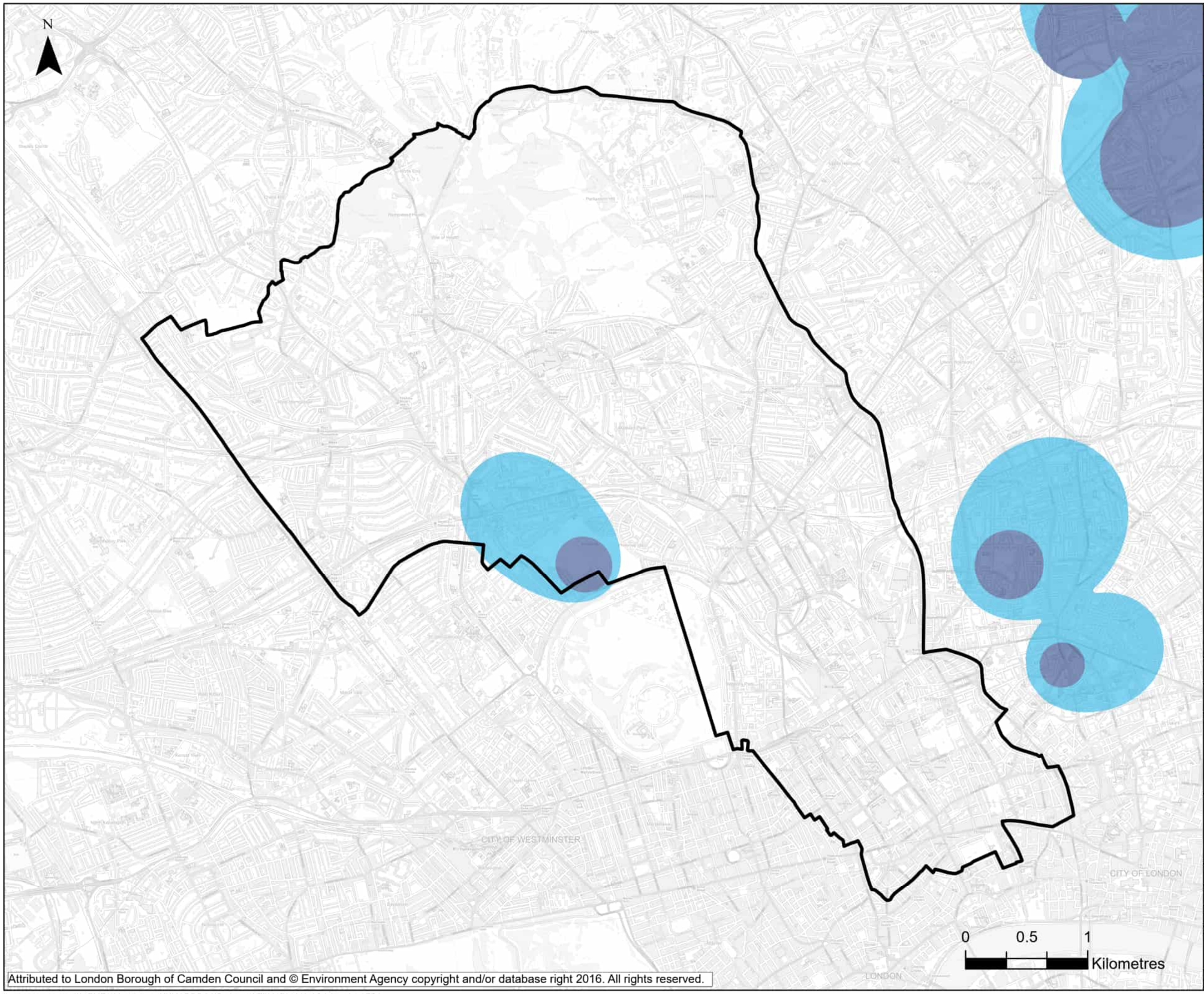
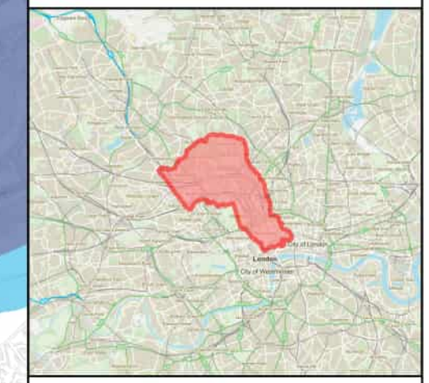


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Source Protection Zones

- Zone 1
- Zone 2

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Source Protection Zones

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 21

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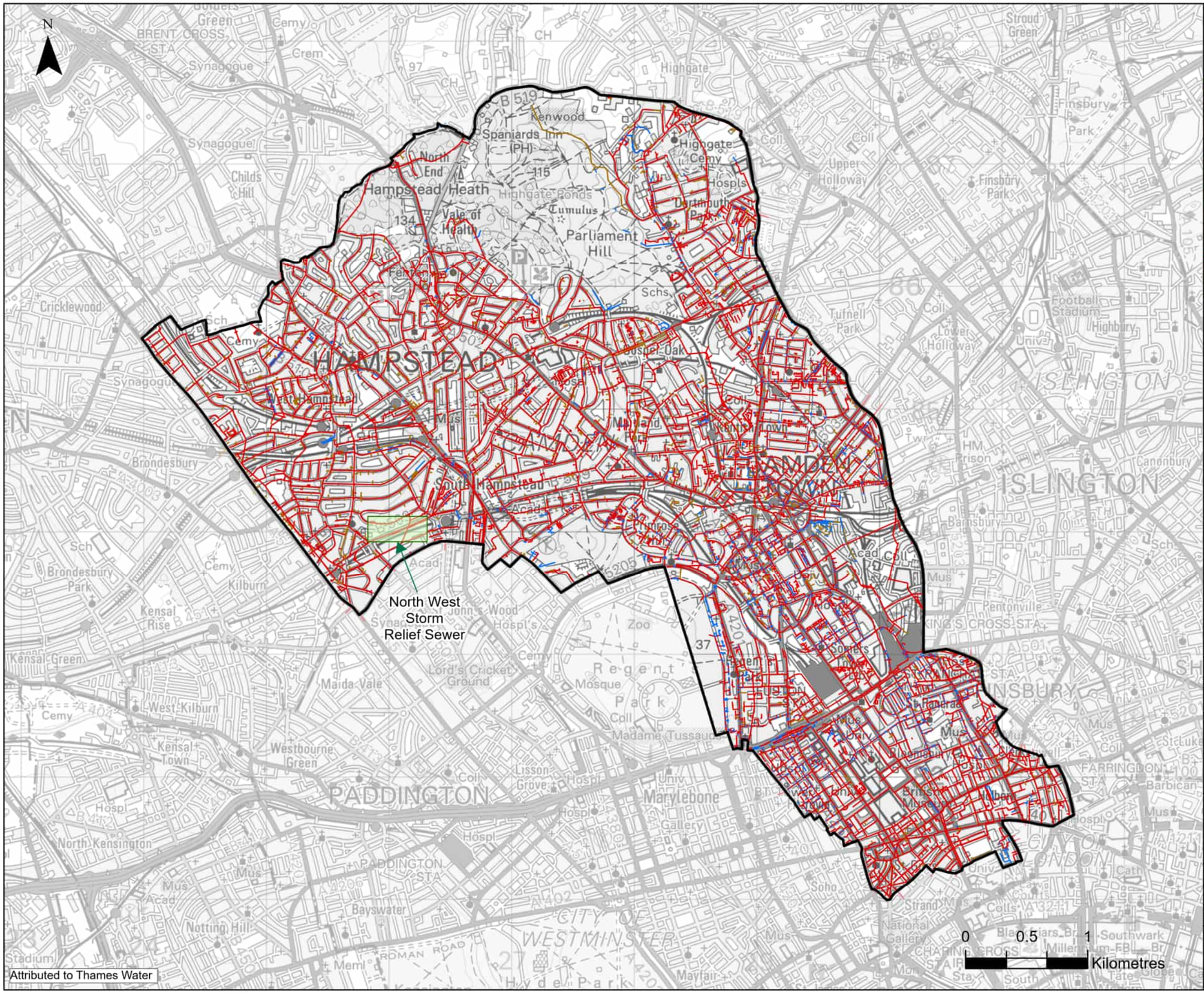
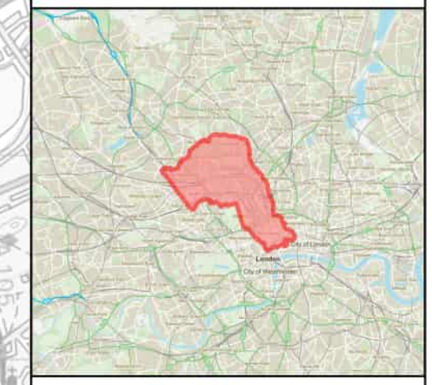


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Thames Water Sewer Map Outputs

(2023)

- Combined
- Foul
- Surface Water

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use

Drawing Status: FINAL

Drawing Title: Thames Water Sewer Mapping: Network Type

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 22

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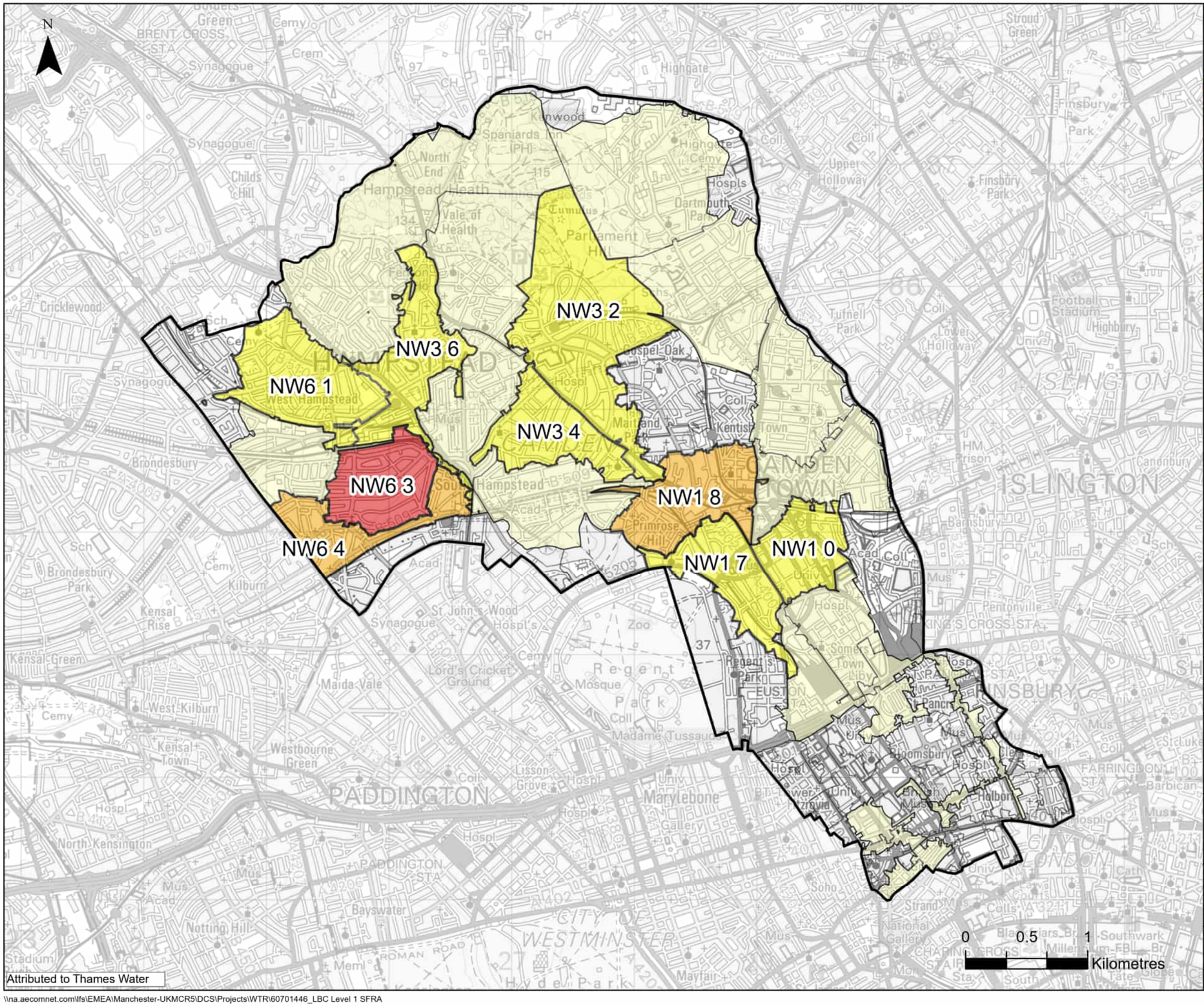
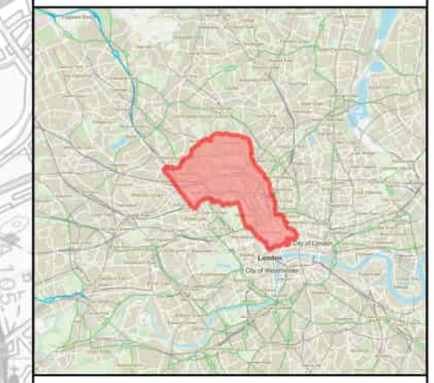


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Sewer Incident Total (2013 - 2023)

- 0-5
- 6-20
- 21-40
- 41-60
- 60+

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Reported Incidents of Sewer Flooding (January 2013 - April 2023)

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 23

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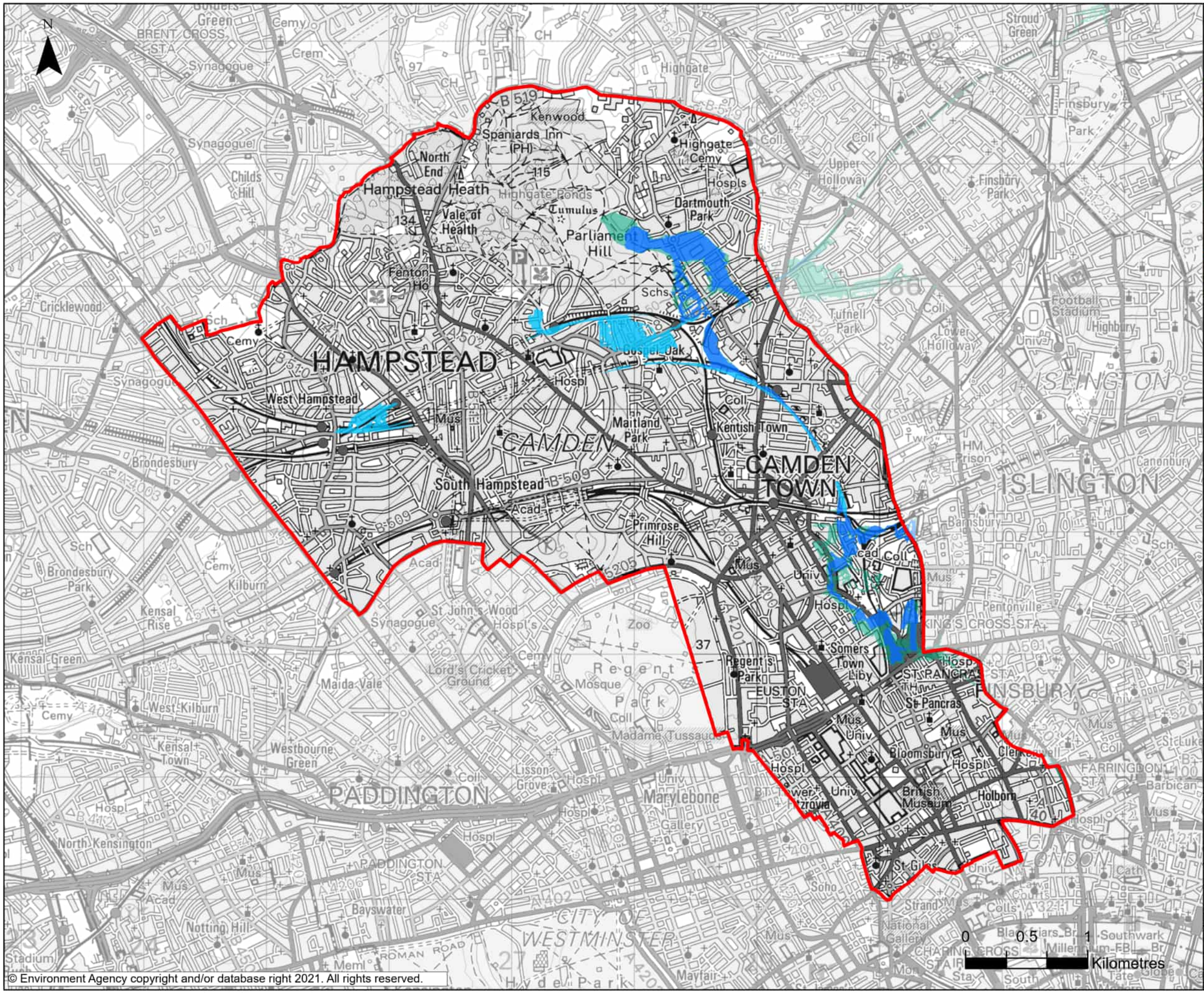
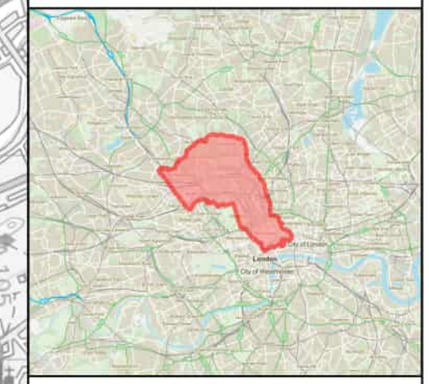


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Flood Extent - Wet Day Scenario

- Hampstead No 1 Pond
- Highgate No 2 Pond
- Highgate No 3 Pond

Notes	This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.
Drawing Status	FINAL
Drawing Title	Reservoir Flood Map Wet Day Scenario
Client	Camden
Scale at A3	1:30,000
Drawn	RR
Checker	HW
Approver	SL
Date	10/01/2024
AECOM	AECOM 4th Floor 100 Embankment Manchester M3 7FB Tel: 0161 601 1700
Project Number	60701446
Figure	24

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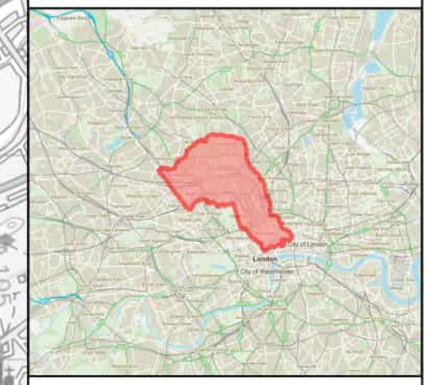
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Flood Extent - Dry Day Scenario

- Hampstead No 1 Pond
- Highgate No 2 Pond
- Highgate No 3 Pond
- Maiden Lane

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Reservoir Flood Map
Dry Day Scenario

Client: Camden

Scale at A3	1:30,000
Drawn: RR	Checker: HW
Approver: SL	Date: 10/01/2024

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Project Number: 60701446

Figure: 25

0 0.5 1 Kilometres

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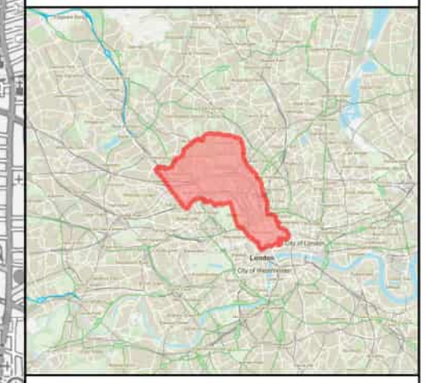
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden

Spatial Flood Defence

- Embankment
- Flood Gate
- Natural High Ground
- Wall

AIMS Structure

- Weir
- Outfall
- Debris Screen
- Ramp
- Security Screen

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Flood Defences and AIMS Structures

Client: Camden

Scale at A3	1:37,000		
Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

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Project Number: 60701446

Figure: 26

0 0.5 1 Kilometres

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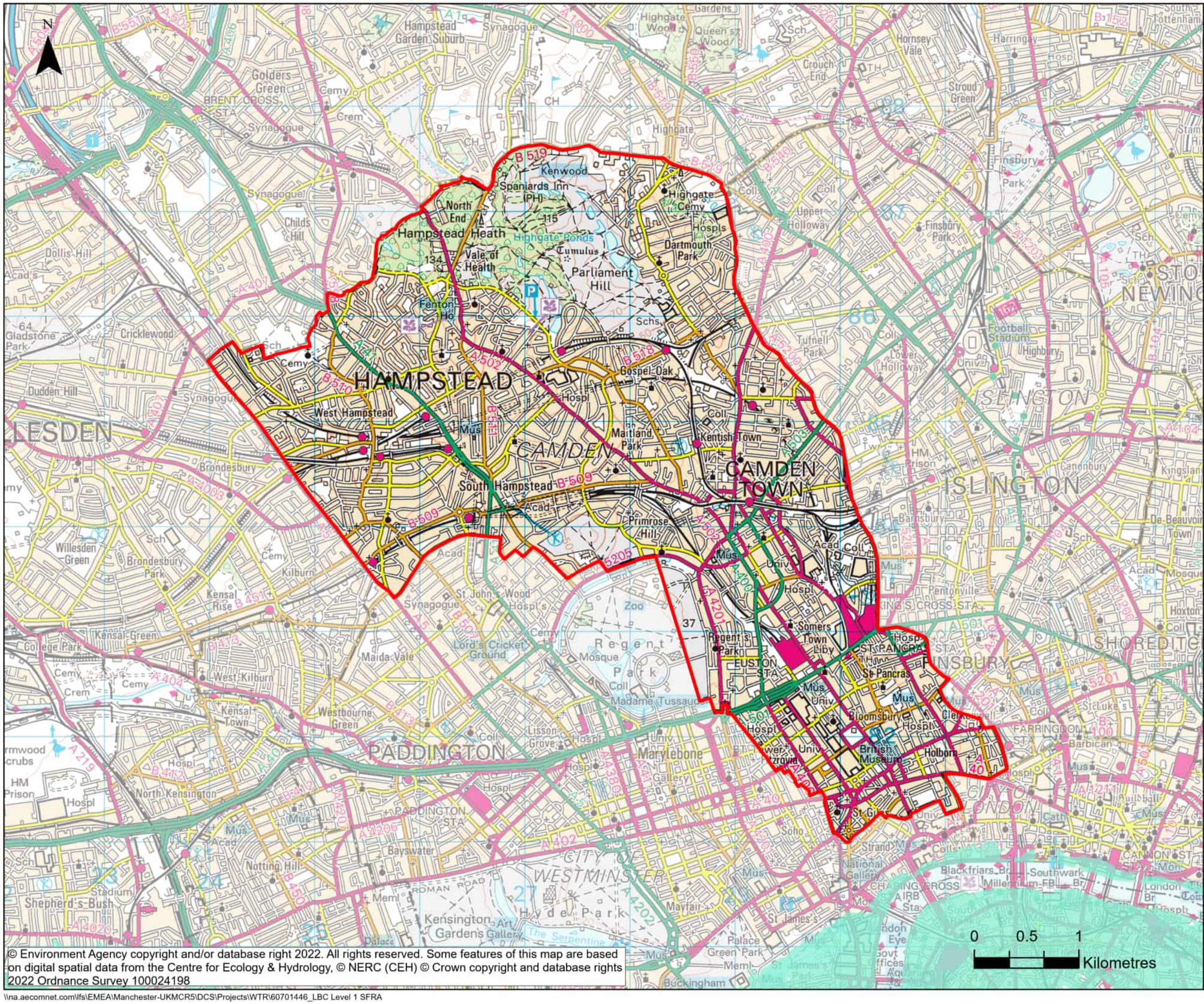

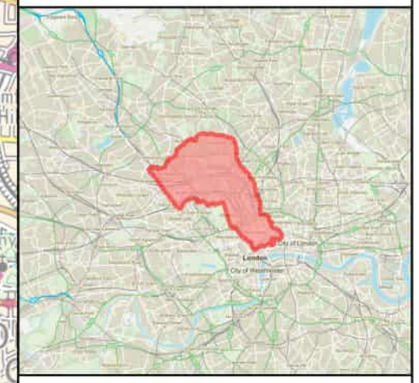

Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment

Legend

- London Borough of Camden
- Reduction in Risk of Flooding from Rivers and Sea due to Defences

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Reduction in Risk of Flooding from Rivers and Sea due to Defences

Client: Camden

Scale at A3	1:35,000		
Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

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Project Number: 60701446

Figure: 27

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Flood Warning Area: Mutton Brook at Hampstead Garden Suburb

Flood Warning Area: River Brent in the London Borough of Barnet

Flood Warning Area: Tidal Thames from London Bridge to Hungerford Bridge

Flood Warning Area: Tidal Thames from the Limehouse Basin to Blackfriars Bridge

Flood Warning Area: Tidal Thames from Blackfriars Bridge to Vauxhaul Bridge

Flood Warning Area: Tidal Thames at Hammersmith and West Kensington

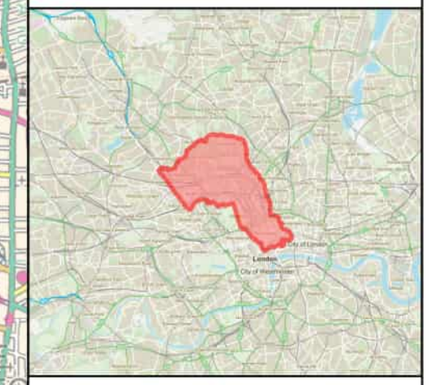
Flood Warning Area: Tidal Thames at Westminster

Attributed to London Borough of Camden Council

0 0.5 1 Kilometres

Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Flood Warning Area

Flood Alert Area

- Groundwater flooding in South East London
- River Brent from Hendon to Brentford
- Tidal Thames in the boroughs of Greenwich, Lewisham, Southwark, Lambeth and Wandsworth
- Tidal Thames in the boroughs of Kensington and Chelsea, Hammersmith and Fulham, Ealing and Hounslow
- Tidal Thames in the boroughs of Tower Hamlets, City of London, City of Westminster, Ken and Chelsea
- Tidal Thames riverside from the Thames Barrier to Putney Bridge

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: London Borough of Camden Administrative Area

Client: Camden

Scale at A3: 1:37,000

Drawn: RR | Checker: HW

Approver: SL | Date: 10/01/2024

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Project Number: 60701446

Figure: 28

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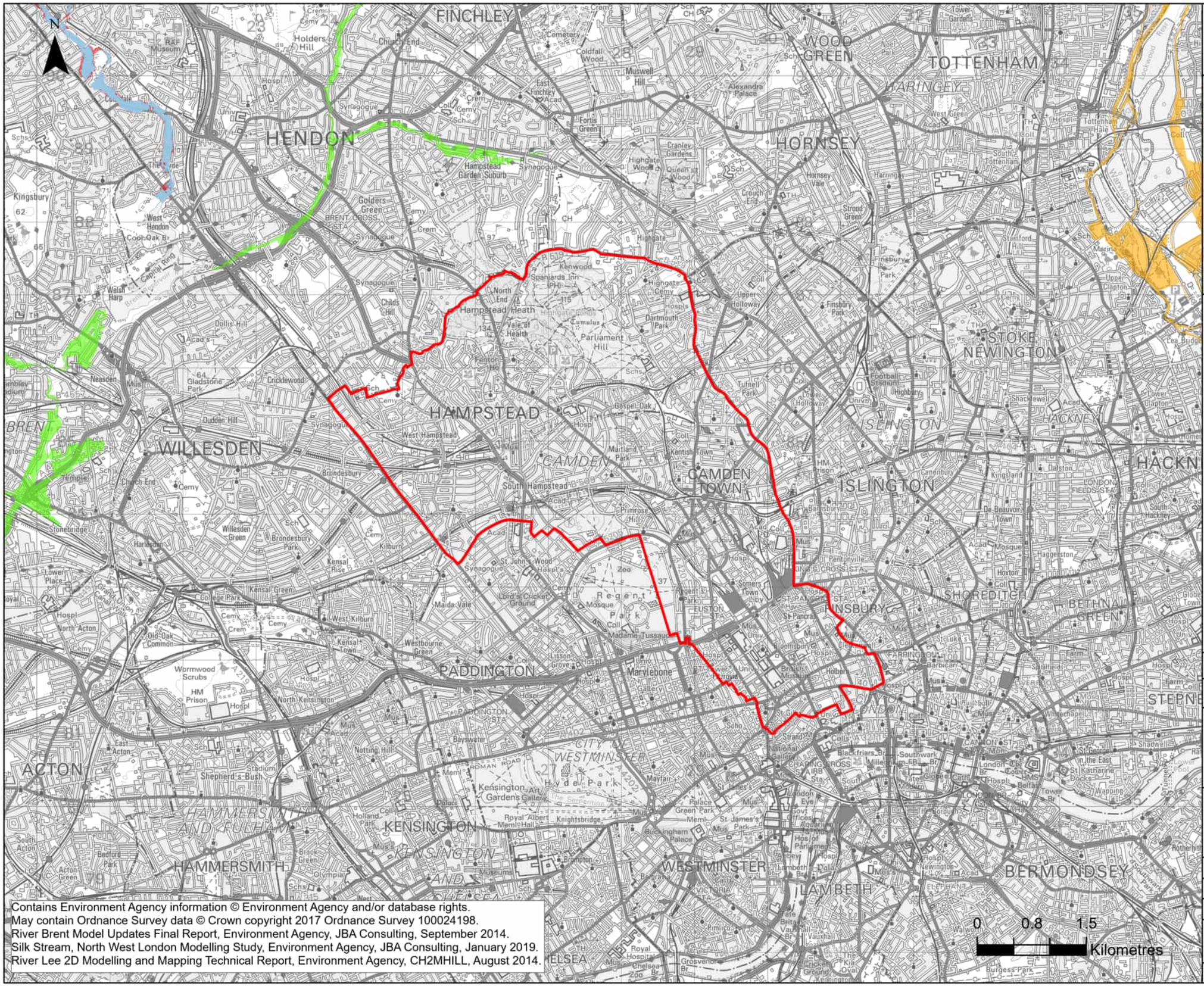

Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment

Legend

- London Borough of Camden
- River Lee 1% AEP (+20%)
- River Brent 1% AEP (+20%)
- Silk Stream 1% AEP (+25%)
- Silk Stream 1% AEP (+35%)
- Silk Stream 1% AEP (+70%)

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Maximum Flood Extent
1% AEP (+Climate Change)
Defended Scenario

Client: Camden

Scale at A3: 1:50,000

Drawn: RR | Checker: HW

Approver: SL | Date: 10/01/2024

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Tel: 0161 907 3500

AECOM

Project Number: 60701446

Figure: 29

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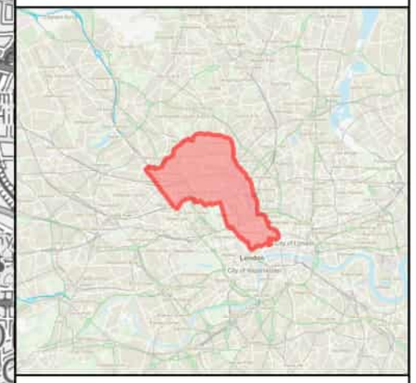
Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- 2005 Epoch River Thames Tidal Breach Extent
- 2100 Epoch River Thames Tidal Breach Extent

0 0.5 1 Kilometres

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Maximum Flood Extent 2005 and 2100 Epoch River Thames Tidal Breach Scenario

Client: Camden

Scale at A3: 1:35,000

Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

AECOM
AECOM
100 Embankment
Cathedral Approach
Manchester
M3 7FB
Tel: 0161 907 3500

AECOM

Project Number: 60701446

Figure: 30

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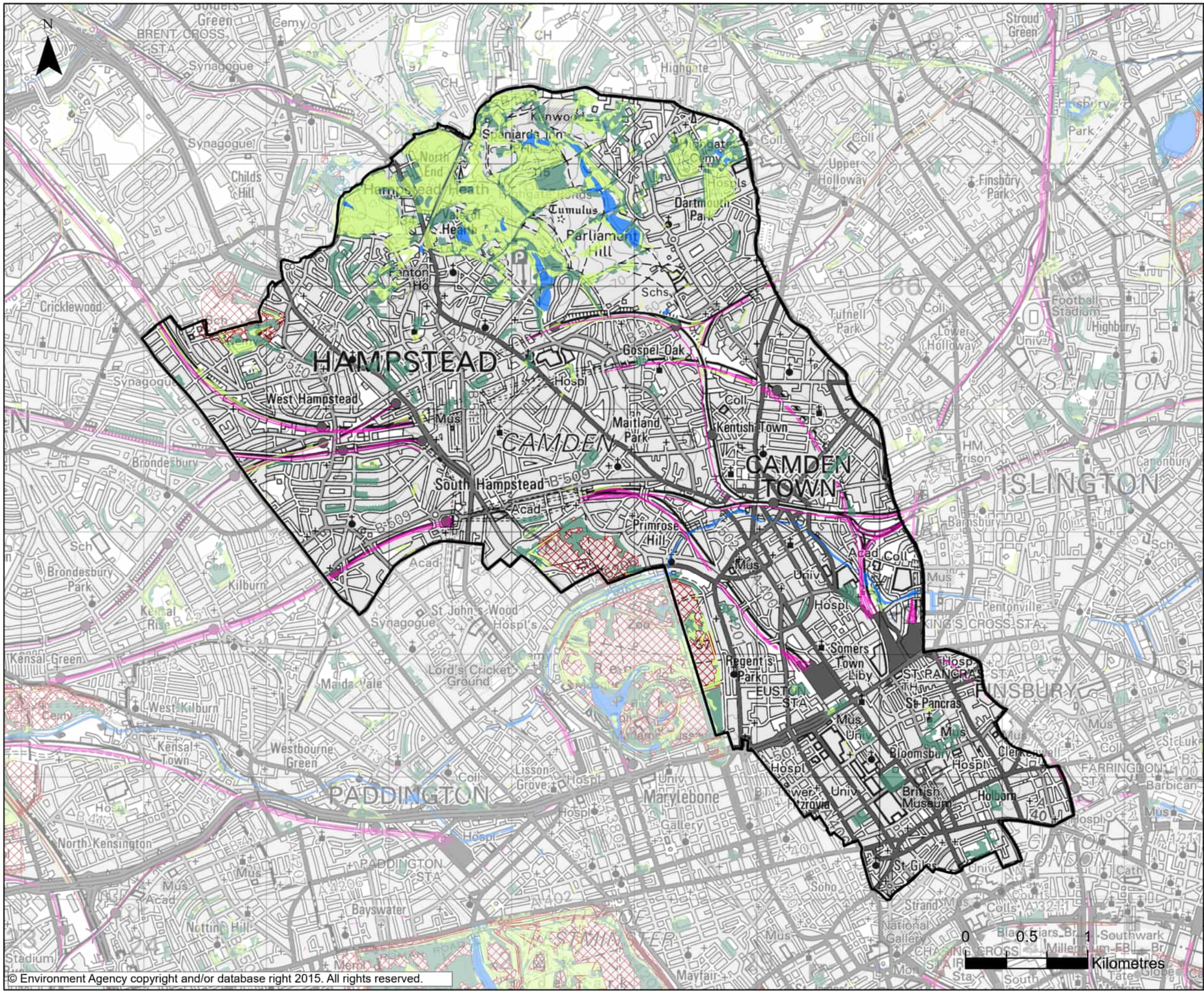
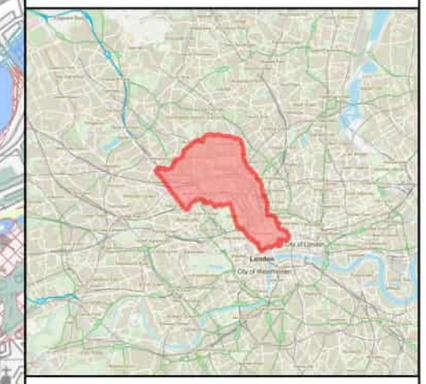


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- WWNP - Wider Catchment Woodland Potential
- WWNP - Riparian Woodland Potential

WWNP - Woodland Constraints

- Forestry Commission - Woodland Inventory 2015
- Woodland
- Waterbody
- Rail

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Working With Natural Processes (WWNP) - Potential and Constraints

Client: Camden

Scale at A3: 1:30,000

Drawn	RR	Checker	HW
Approver	SL	Date	10/01/2024

AECOM
AECOM
4th Floor
100 Embankment
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AECOM

Project Number: 60701446

Figure: 31

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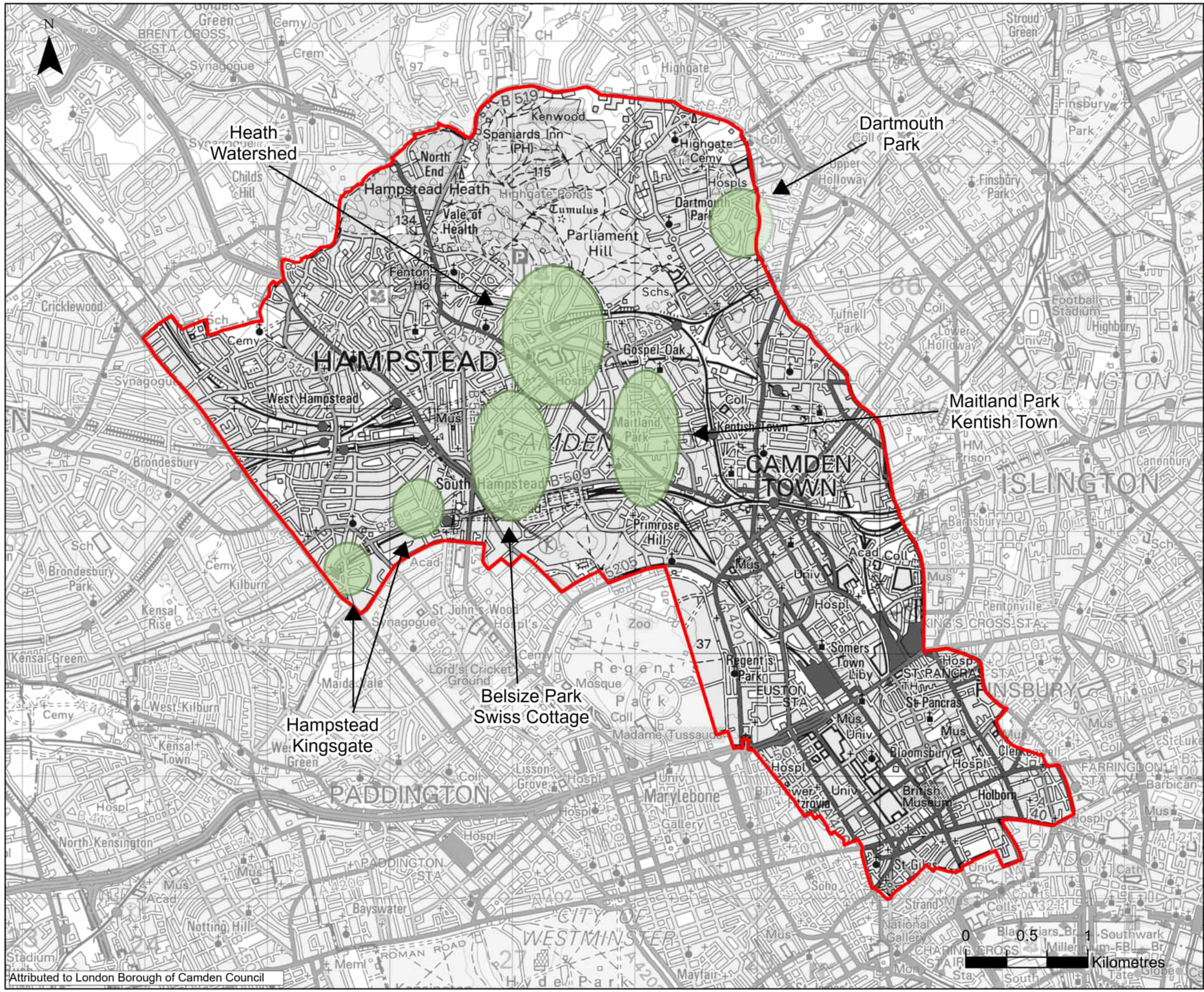
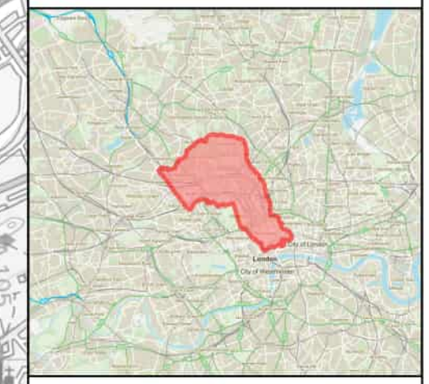


Job Title

London Borough of Camden
Level 1
Strategic Flood Risk Assessment



Legend

- London Borough of Camden
- Section 19 Flood Investigation Report - Focus Areas

Notes: This map is intended to provide a strategic overview and should not be used to assess individual properties. Refer to the accompanying SFRA Report for details of the datasets and purpose of their use.

Drawing Status: FINAL

Drawing Title: Section 19 Flood Investigation Report Focus Areas

Client: Camden

Scale at A3: 1:30,000

Drawn	Checker
RR	HW
Approver	Date
SL	10/01/2024

AECOM
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AECOM

Project Number: 60701446

Figure: 32

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Appendix B Data Register

Data Register: London Borough of Camden - Strategic Flood Risk Assessment

Date Source Reference	Data Type	Data Name	Received From
London Borough of Camden			
LBC001	PDF	Camden Flood Risk Management Strategy (2022)	London Borough of Camden
LBC002	PDF	Camden Surface Water Management Plan (2011)	London Borough of Camden
LBC003	PDF	Floods in Camden report of the floods scrutiny panel LBC (June 2003)	London Borough of Camden
LBC004	Word	Environment Agency Response to Local Plan Review	London Borough of Camden
LBC005	Word	Thames Water Response to Local Plan Review	London Borough of Camden
LBC006	GIS	General Files: Critical Drainage Area, Local Flood Risk Zone, bedrock geology, superficial geology, bedrock permeability, superficial permeability, superficial deposits region, superficial thickness)	London Borough of Camden
LBC007	GIS	Flooded Street Data 1975, 2002, 2021	London Borough of Camden
LBC008	GIS	Allocated Site Policies	London Borough of Camden
LBC009	Excel	Camden Flood Asset Register	London Borough of Camden
LBC010	GIS	Aquifer Designation	London Borough of Camden
LBC011	GIS	Groundwater Flood Incidents	London Borough of Camden
LBC012	GIS	Hydro Constrains Surface Water	London Borough of Camden
LBC013	GIS	Hydro Constrains Groundwater	London Borough of Camden
LBC014	GIS	SALP Site Policies	London Borough of Camden
LBC015	GIS	Groundwater Flood Incidents	London Borough of Camden
LBC016	GIS	Historic Rivers	London Borough of Camden
LBC017	GIS	Postcode Areas	London Borough of Camden
LBC018	Word	Policy 5 - Managing water and flood risk	London Borough of Camden
LBC019	GIS	OS50 Map	London Borough of Camden
LBC020	Excel	Proposed Interventions	London Borough of Camden
LBC021	Word	Multi Agency Flood Plan (April 2023)	London Borough of Camden
Emapsite (on behalf of London Borough of Camden)			
ES001	TIF	Cassini Old Series Map (1805_1874)	Emapsite
ES002	DBF	County Region	Emapsite
ES003	GIS & TIF	OS 1:50,000 Raster	Emapsite
ES004	GIS & TIF	OS 1:250,000 Raster	Emapsite
ES005	GIS & TIF	OS Miniscale 1:1,000,000	Emapsite

ES006	ASC	OS Landform Panorama DTM	Emapsite
ES007	GIS & TIF	OS Vector Map District Raster	Emapsite
ES008	GIS	Woodland Region	Emapsite
Environment Agency			
EA001	Various	Brent Model Updated Study 2014	Environment Agency
EA002	Various	Brent Updated CC Runs 2017	Environment Agency
EA003	Various	River Lee 2D Modelling Study 2014	Environment Agency
EA004	Various	Salmons Brook Flood Alleviation Scheme 2015	Environment Agency
EA005	Various	Silk Stream Modelling Study 2019	Environment Agency
EA006	Various	Thames Tidal Upriver Breach Modelling 2017	Environment Agency
EA007	Various	Thames Upriver Breach Model P5	Environment Agency
EA008	Various	Tidal P7	Environment Agency
Thames Water			
TW001	Excel	Flood Incident Data - DG5 Records (Postcode Areas Only)	Thames Water
TW002	GIS	Sewer Infrastructure - GIS Files	Thames Water
TW003	Excel	Camden Planned Cleans	Thames Water
TW004	GIS	Counters Creek - GIS Files	Thames Water
TW005	GIS	Beckton Model Extract	Thames Water
British Geological Survey			
BGS 001	GIS	Susceptibility to Groundwater Flooding	British Geological Survey
City of London Corporation			
CoLC 001	n/a	Information on Historic Flood Events (Use of Data from S19)	City of London Corporation
CoLC 002	Web	Hampstead Heath Ponds Project	City of London Corporation
CoLC 003	Email	On-Site Emergency Response Plan Summary	City of London Corporation
Canal and River Trust			
CRT001	GIS	Breach archive	Canal and River Trust
CRT002	GIS	Overtopping archive	Canal and River Trust
Transport for London			
TfL001	Excel	Camden Drainage (Schemes March'23)	Transport for London
TfL002	Excel	Historic ponding flooding incidents	Transport for London
TfL003	Excel	Maximo ponding flooding incidents to Mar23	Transport for London
Open Data			

Open 001	GIS	AIMS Channel	Environment Agency
Open 002	GIS	AIMS Structure	Environment Agency
Open 003	GIS	Spatial Flood Defences Including Standardised Attributes	Environment Agency
Open 004	GIS	Flood Map for Planning Rivers and Sea Flood Storage Areas	Environment Agency
Open 005	GIS	Flood Map for Planning Rivers and Sea Flood Zone 2	Environment Agency
Open 006	GIS	Flood Map for Planning Rivers and Sea Flood Zone 3	Environment Agency
Open 007	GIS	Historic Flood Map	Environment Agency
Open 008	GIS	Recorded Flood Outlines	Environment Agency
Open 009	GIS	Statutory Main River Map	Environment Agency
Open 010	GIS	Reduction in Risk of Flooding from Rivers and Sea	Environment Agency
Open 011	GIS	Reservoir Mapping: Hampstead Pond No 1	Environment Agency
Open 012	GIS	Reservoir Mapping: Highgate Pond No 2	Environment Agency
Open 013	GIS	Reservoir Mapping: Highgate Pond No 2	Environment Agency
Open 014	GIS	Reservoir Flood Extents - Fluvial Contribution	Environment Agency
Open 015	GIS	Risk of Flooding from Rivers and Sea	Environment Agency
Open 016	GIS	Flood Warning Areas	Environment Agency
Open 017	GIS	Flood Alert Areas	Environment Agency
Open 018	GIS	BGS Geology 625k data - Bedrock	British Geological Survey
Open 019	GIS	BGS Geology 625k data - Superficial	British Geological Survey
Open 020	GIS	BGS Hydrogeology	British Geological Survey
Open 021	TIF	LiDAR - 2m DTM	Environment Agency
Open 022	GIS	WFD Operational Catchment	Environment Agency
Open 023	GIS	OS Code Point	Ordnance Survey
Open 024	GIS	OS Open Rivers	Ordnance Survey
Open 025	GIS	Source Protection Zones	Environment Agency
Open 026	GIS	Regent's Canal - WFD Waterbody	Environment Agency
Open 027	GIS	Reservoir Mapping: Dry Day	Environment Agency
Open 028	GIS	Reservoir Mapping: Wet Day	Environment Agency
Open 029	GIS	Risk of Surface Water Flooding	Environment Agency
Open 030	GIS	Working With Natural Processes Data	Environment Agency

Appendix C Climate Change Allowances

The London Borough of Camden is found within the London Management Catchment and the Thames River Basin. The climate change allowances for these regions (as outlined within the PPG) are included within **Table 8-1**, to include: peak river flow, peak rainfall intensity and sea level allowances.

Peak rainfall intensity allowances are directly applicable to the Camden Borough, whereas peak river flow and sea level allowances are included for reference only.

As the Camden Borough is not situated on the English coastline the allowance for offshore wind speed and extreme height allowance is not included within **Table 8-1**.

Table 8-1: Climate Change Allowances – London Management Catchment and Thames River Basin

Type of Allowance	Camden Borough – Allowance Value					
Peak river flow allowances[110]: London Management Catchment Peak River Flow Allowances		Central	Higher	Upper		
	2020s	10%	14%	26%		
	2050s	7%	14%	30%		
	2080s	17%	27%	54%		
Peak rainfall intensity allowances[111]: London Management Catchment Peak Rainfall Allowances		3.3% AEP Event				
		Central		Upper		
	2050s	20%		35%		
	2070s	20%		35%		
		1% AEP Event				
		Central		Upper		
	2050s	20%		40%		
	2070s	25%		40%		
Sea level allowances[112]: South East River Basin Sea Level Allowances*		2000-2035 (mm)	2036-2065 (mm)	2066-2095 (mm)	2096-2125 (mm)	Cumulative rise 2000-2125 (m)
	Higher Central	5.8	8.8	11.7	13.1	1.21
	Upper End	6.9	11.3	15.8	18.2	1.60

Although situated within the Thames River Basin, the sea level allowance for the Camden Borough is based upon the South East River Basin, as advised within the PPG[63].

[110] Environment Agency. Climate Change Allowances for Peak River Flow (2022). [Online]. Available: https://environment.data.gov.uk/hydrology/climate-change-allowances [Accessed: 02/05/2023]
[111] Environment Agency. Climate Change Allowances for Peak Rainfall (2022). [Online]. Available: https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall [Accessed: 02/05/2023]
[112] Environment Agency. Guidance: Flood Risk Assessments – Climate Change Allowances. (2022). [Online]. Available: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#river-basin-district [Accessed: 02/05/2023]

Peak River Flow Allowances

For peak river flow allowances, the percentiles represented in **Table 8-1** describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for each peak fall below it and above it. The allowances are listed below.

- Central allowance is based on the 50th percentile;
- Higher Central allowance is based on the 70th percentile; and
- Upper End allowance is based on the 95th percentile.

In addition, three primary epochs are used:

- '2020s' (2015-2039);
- '2050s' (2040-2069); and
- '2080s' (2070-2125).

Peak Rainfall Intensity Allowances

8.4.3 For peak rainfall intensity allowances, the development lifetime should be used to determine the relevant epoch. This is detailed below:

- Developments with a lifetime beyond 2100 should assess the upper end allowances for both the 3.3% and 1% AEP event of the 2070s epoch;
- Developments with a lifetime between 2061 and 2100 should assess the central allowance for both the 3.3% and 1% AEP event of the 2070s epoch; and
- Developments with a lifetime up to 2060 should assess the central allowance for both the 3.3% and 1% AEP event of the 2050s epoch.

Sea Level Allowances

8.4.4 The sea level allowances range according to the basin district and epoch. These are represented by percentiles, as listed below:

- Higher Central allowance is based on 70th percentile; and
- Upper End allowance is based on the 95th percentile.

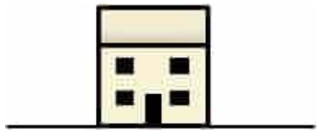
Appendix D Camden Geological, Hydrogeological and Hydrological Study – Effect of Basements on Groundwater Flow

Scenario

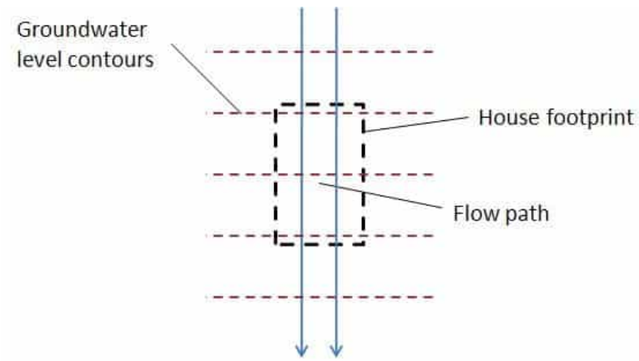
Plan (from above)

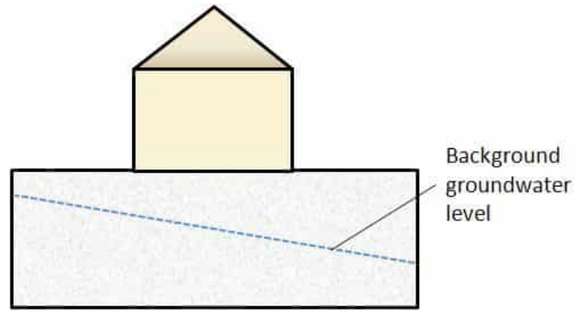
Section (from the side)

A



No basement





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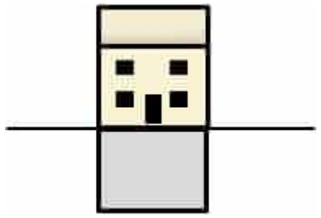
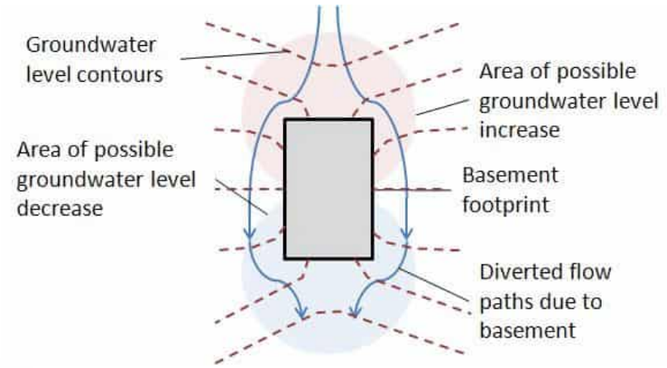
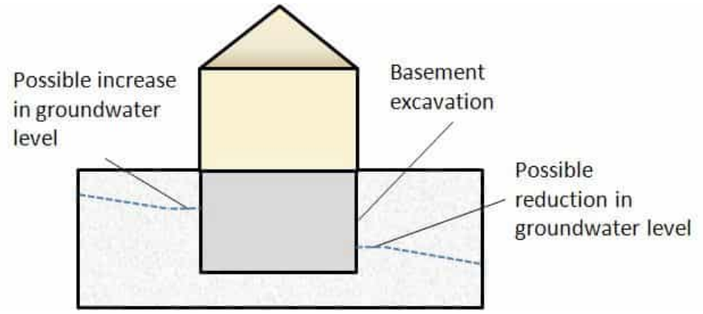


Single basement structure – no adjoining basements





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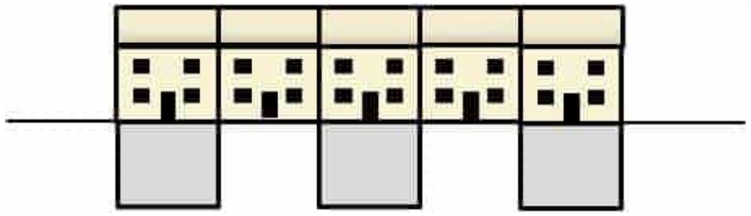
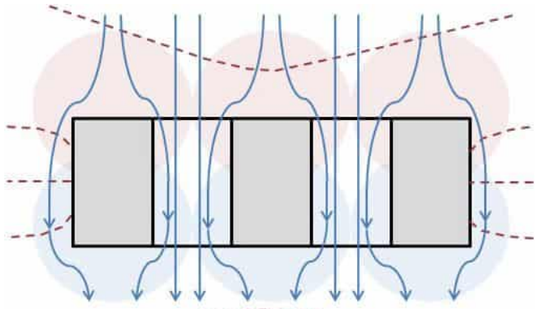
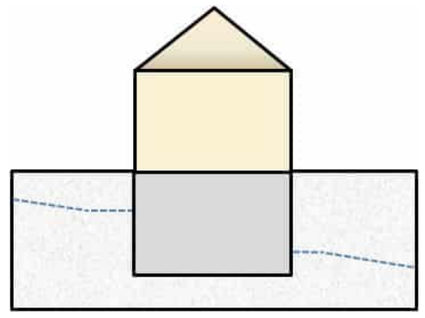


Multiple basement structures – no adjoining basements





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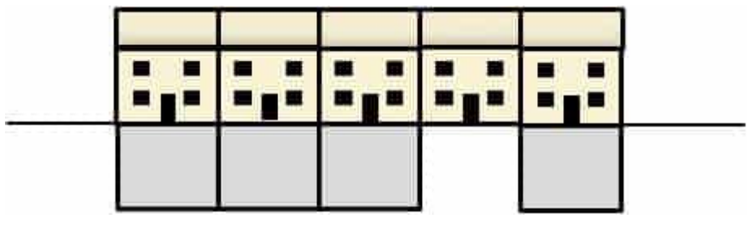
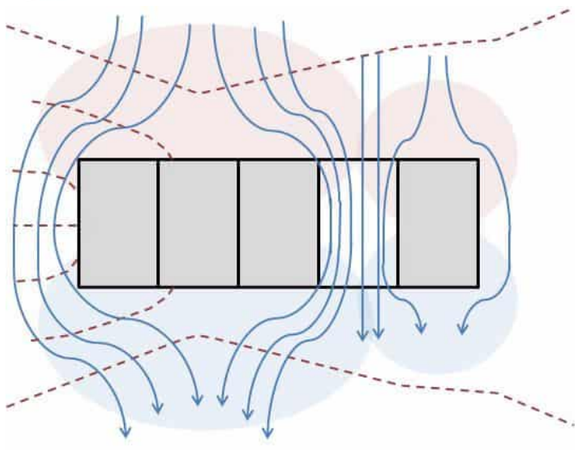
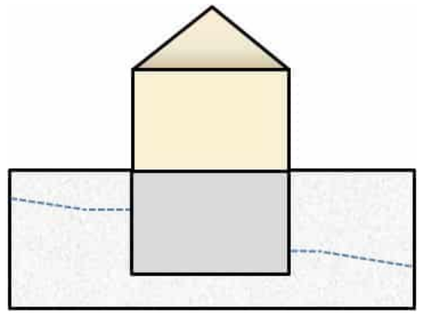


Multiple basement structures – adjoining basements





Not to scale

Camden Geological, Hydrogeological and Hydrological Study
Illustration of effect of basements on groundwater flow

213923

FIGURE **23**

Appendix E Site-Specific Flood Risk Assessment Checklist

1. Development Description and Location	
1a. What type of development is proposed (e.g. new development, an extension to existing development, a change of use) and where will it be located?	☐
1b. What is its flood risk vulnerability classification? Refer to Section 6.	☐
1c. Is the proposed development consistent with the Local Plan? *Refer to the Local Plan and seek advice from Camden Council if necessary*	☐
1d. What evidence can be provided that the Sequential Test and where necessary the Exception Test has/have been applied in the selection of this site for the development type? *Consult Camden Council to determine if the site has been included in the Sequential Test. If not, refer to Section 6 for guidance on undertaking the Sequential Test for individual development sites and to determine whether the Exception Test is required*.	☐
1e. Will your proposal increase overall the number of occupants and/or users of the building/land, or the nature or times of occupation of use, such that it may affect the degree of flood risk to these people? *This is particularly relevant to minor developments (alterations and extensions) and changes of use.*	☐
2. Definition of the Flood Hazard	
2a. What sources of flooding could affect the site? *Refer to Section 5 of the London Borough of Camden Strategic Flood Risk Assessment.*	☐
2b. For each identified source under 2a above, can you describe how flooding would occur, with reference to any historic records where these are available? *Refer to Section 3.1 and Section 5 of the London Borough of Camden Strategic Flood Risk Assessment.*	☐
2c. What are the existing surface water drainage arrangements for the site? *Undertake a site survey to determine specific details. Where appropriate an asset location survey can be provided by Thames Water*	☐
3. Probability	
3a. Which flood zone is the site within? *In the case of the London Borough of Camden, the borough is entirely within Flood Zone 1 as defined by the Environment Agency Flood Map for Planning. Therefore, Section 3a of this checklist does not apply.*	☐
3b. Does the SFRA show the same or a different flood zone compared with the Environment Agency Flood Map for Planning? *The London Borough of Camden Strategic Flood Risk Assessment and the Environment Agency Flood Map for Planning indicate that the borough is entirely within Flood Zone 1. If different you should seek advice from the local planning authority and, if necessary, the Environment Agency (enquiries@environment-agency.gov.uk).*	☐
3c. What is the probability of the site flooding, taking account of maps of Flood Map for Planning and Risk of Flooding from Surface Water available and the Strategic Flood Risk Assessment, and of any further flood risk information for the site. Refer to Section 5, as well as the Flood Map for Planning and Risk of Flooding from Surface Water mapping available on the Environment Agency website. In the case of the London Borough of Camden, the Flood Map for Planning is not applicable due to the Borough's location entirely within Flood Zone 1.	☐
3d. If known, what (approximately) are the existing rates and volumes of surface water runoff generated by the site?	☐

4. Climate Change	
4a. How is flood risk at the site likely to be affected by climate change? No main rivers are located within *the London Borough of Camden, meaning there is no flood risk from fluvial sources. Refer to Section 4.5 for a description of how climate change will impact other sources of flooding.*	☐
5. Detailed Development Proposals	
5a. Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding (including providing details of the development layout)? *Refer to Section 6 of the Strategic Flood Risk Assessment regarding the use of the sequential approach within development sites.*	☐
6. Flood Risk Management Measures	
6a. How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime? Refer to Section 7.2 of the Strategic Flood Risk Assessment for details regarding finished floor levels, basement dwellings, flood resilient design, car parking considerations, and provision of safe access / egress.	☐
7. Off-Site Impacts	
7a. How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere? Refer to Section 7.2 of the Strategic Flood Risk Assessment regarding off-site impacts including flood routing.	☐
7b. How will you prevent runoff from the completed development causing an impact elsewhere? *Refer to Section 7.2 regarding the use of specific types of SuDS throughout the Borough.*	☐
7c. Are there any opportunities offered by the development to reduce flood risk elsewhere? *Refer to Section 7.2 regarding the use of specific types of SuDS throughout the Borough.*	☐
8. Residual Risk	
8a. What flood-related risks will remain after you have implemented the measures to protect the site from flooding?	☐
8b. How, and by whom, will these risks be managed over the lifetime of the development? (e.g. flood warning and evacuation procedures). *Refer to Section 7.2 for details regarding flood warning and flood evacuation plans.*	☐