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STRATEGIC FLOOD RISK ASSESSMENT

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Term	Definition
Annual Exceedance Probability (AEP)	In flood risk terms, the AEP represents the probability of a particular return period event occurring in any given year. (e.g. 1 in 100 year return period event = 1% AEP – there is a 1% chance every year that this event will take place).
Areas Benefiting from Defences	The area that is protected by a defence or defence system against flooding from fluvial or tidal flooding (e.g. Westminster), assuming all defences remain intact and function perfectly.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water.
Brownfield Land	Previously developed land.
Catchment	The land (and its area) which drains (normally naturally) to a given point on a river, drainage system or other body of water.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Climate Change (CC)	Long term variations in global temperature and weather patterns caused by natural and human actions. Climate change affect also sea and river levels and rainfall intensity.
Critical Drainage Area	The CDAs are discrete geographic areas, usually a hydraulic catchment, where there are multiple and interlinked sources of flood risk.
Exception Test	The Exception Test is required for certain development sites following application of the Sequential Test. The Exception Test must demonstrate that the development provides wider sustainability benefits to the community that outweigh flood risk, and that the site is safe from flood risk for its lifetime.
Flood Defence	Flood defence infrastructure, such as flood walls and embankments, intended to protect an area against flooding to a specified Standard of Protection. For example the Thames Barrier and associated Thames Tidal Flood Defences protect against tidal flood event with a 0.1% Annual Expected Probability.
Flood Map for Planning	A map produced by the Environment Agency providing an indication of the likelihood of flooding from rivers or the sea within all areas of England and Wales, assuming there are no flood defences.

Term	Definition
Flood Resilience	Measures that promote fast drying and easy cleaning, to prevent any permanent damage and ensuring quick recovery.
Flood Resistant	Measures to prevent flood water entering a building or damaging its fabric.
Flood Risk Assessment (FRA)	Study investigating the potential sources of flooding for a site and the mitigation measures required to ensure its safe development without increasing the flood risk elsewhere; a FRA is generally required at planning stage, refer to the National Planning Policy Framework.
Flood Risk Management	The activity of understanding the probability and consequences of flooding, and seeking to modify these factors to manage flood risk to people, property and the environment in line with agreed policy objectives
Flood Warning	Generally provided by the Environment Agency through their Flood Warning Direct Service, it means flooding is expected in an area or flooding is already happening there.
Flood Zone	Area with a defined probability of fluvial/tidal flooding as per the classification in the National Planning Policy Framework. The flood zones do not take into account the presence of flood defences. See following lines
Flood Zone 1	Land where the probability of fluvial/tidal flooding is classified as Low (assuming no flood defences). There is less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year.
Flood Zone 2	Land where the probability of fluvial/tidal flooding is classified as Medium (assuming no flood defences). Land which has between a one in 100 and one in 1000 annual probability (chance) of river flooding (1% -0.1%); or between a one in 200 and 1 in 1000 annual probability (chance) of sea flooding (0.5%-0.1%).
Flood Zone 3	Land where the probability of fluvial/tidal flooding is classified as High (assuming no flood defences). Land which has a greater than one in 100 annual probability (chance) of river flooding (>1%); or greater than one in 200 annual probability (chance) of sea flooding (>0.5%).
Flooding Hotspot	Also known as flood prone areas. These are locations where concentrations of flooding incidents within a limited geographical context have appeared over time.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow in the absence of flood defences.

Term	Definition
Greenfield Runoff Rate	The greenfield runoff rate is the rate at which rainfall would runoff from an undeveloped, naturally permeable catchment.
Main River	A large river or stream designated on a statutory map of Main Rivers, on which the Environment Agency carries out maintenance, improvement or construction works to manage flood risk.
National Planning Policy Framework	The NPPF sets out the Government's planning policies for England and how these are expected to be applied.
Ordinary Watercourse	All rivers, streams, ditches, drains, cuts, dykes, sluices, sewers (other than public sewers) and passages through which water flows which do not form part of a Main River. Local authorities and, where relevant Internal Drainage Boards, have similar permissive powers on Ordinary Watercourses as the Environment Agency has on Main Rivers.
Overtopping	The process of water rising over the top of a barrier intended to contain it (e.g. sea defence).
Planning Practice Guidance	Provides additional technical guidance to ensure the effective implementation of the planning policy set out in the National Planning Policy Framework.
Reservoir	A large raised structure, raised lake or other area capable of storing at least 10,000 cubic metres of water above natural ground level, created artificially or enlarged. This is defined by the Reservoirs Act, 1975 and amended by the Flood and Water management Act 2010, Schedule 4.
Residual risk	The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.
Return Period	The long-term average period between events of a given magnitude which have the same annual exceedance probability of occurring.
Run-off	The flow of water from an area caused by rainfall.
Sequential Test	The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding.
Site Allocation	Location identified by the Local Planning Authority as likely to experience change or development in the short to medium term.
Standard of Protection	The design event or standard to which a building, asset or area is protected against flooding, generally expressed as an annual exceedance probability.

Term	Definition
Strategic Flood Risk Assessment	An area-wide study, undertaken by one or more local authorities, to assess the risks that all sources of flooding poses to a Borough or district, both now and in the future. It incorporates the impacts of further land changes and climate change in the development of an area and if these factors impact the risk of flooding.
Surface Water Flooding	Surface water flooding occurs when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.
Sustainable Drainage Systems	A sequence of management practices and control structures, often referred to as SuDS, designed to drain water in a more sustainable manner than some conventional techniques. SuDS can take many forms, both above and below ground and aim to provide benefits in terms of water quantity, water quality, amenity and biodiversity.
Tidal Surge	A local high rise in sea level caused by climatic conditions, creating wind and low atmospheric pressure. Tidal flooding is of greatest risk when tidal surges combine with high tides.
Thames Estuary 2100 Plan	The Environment Agency's plan for maintaining and improving the Thames tidal flood defence system for the period to 2100, taking account of climate change.
Vulnerability Classes	NPPF provides a vulnerability classification to assess which uses of land may be appropriate in each flood risk zone.

1 Introduction

1.1 Overview

1.1.1 This Strategic Flood Risk Assessment (SFRA) is intended to provide an assessment of all sources of flooding, required for consideration under the National Planning Policy Framework (NPPF) within Westminster, taking account of the impacts of climate change. This SFRA also assesses the impact that land use changes and development in the area may have on flood risk. Furthermore, it sets out a number of approaches to avoid, reduce, mitigate and manage this risk as part of a wider objective to ensure sustainable development. In accordance with the NPPF, it is intended to support and inform policies in the Westminster City Plan and to support it in the taking of planning decisions. This document updates the previous SFRA (2019) to incorporate significant changes to the National Planning Policy Framework (NPPF) and Planning practice Guidance (PPG) in relation to flood risk. Furthermore, lessons learnt from the July 2021 flood events and updated datasets have now been incorporated.

1.1.2 Westminster City Council is committed to ensuring the right kind of growth which brings the maximum benefits for its residents, workers, visitors, and businesses whilst minimising the potential for detrimental impacts now and into the future. This approach takes into account the fact that Westminster is already densely developed; its parks, open spaces and heritage are protected, and this increases the demands on those parts of the City which can be developed. This means that policies have to support imaginative and innovative approaches to making the most efficient use of the land resources available to encourage and manage growth in ways that deliver the Council's wider social and economic priorities, enhance the environment, protect the heritage and help deliver a high quality City for All. This SFRA has a key role to play in underpinning these policies and supporting their delivery.

1.1.3 Westminster City Council has prepared a City Plan 2019-2040 (adopted April 2021) which replaces all current policies in Westminster's City Plan (November 2016) and detailed development management policies 'saved' from the 2007 Westminster Unitary Development Plan to produce a single, comprehensive statement of strategic planning policies. This document supports the policy relevant to flooding within the City Plan 2019-2040. Further details of the City Plan are given in section 5 of this document.

1.1.4 The SFRA has been prepared by Westminster City Council as the Local Planning Authority in consultation with the Environment Agency, its Lead Local Flood Authority (LLFA) functions of contingency planning, highways, policy and city management, Thames Water, the Greater London Authority (GLA), the Port of London Authority (PLA) and the Canal and River Trust.

1.2 The Local Context

1.2.1 Westminster City Council is a unitary authority located on the north side of the River Thames in central London, home to a long standing and diverse residential community of 204,300[1] (2021). Although Westminster City Council's Authority Area has a significant area located within Flood Zone 2 and 3, this is associated with the River Thames Tidal Floodplain, which is protected to a high standard by the Thames Barrier and associated Thames Tidal Flood Defences.

1.2.2 The Houses of Parliament and virtually all Government and related departments, No. 10 Downing Street and New Scotland Yard are all located within Flood Zone 3. Buckingham Palace and the Royal Courts of Justice are within 2km of the River Thames.

[1] Based on the 2021 Census results

1.2.3 As well as the River Thames, the city contains other water features, including the Regent's Canal, the Grand Union Canal, Paddington Basin and Little Venice, totalling 6.4km of canal frontage. There are also five 'hidden rivers'; the Westbourne, Tyburn, Tyburn Brook, Kilbourne and Long Ditch. The Serpentine (in Hyde Park) and the lakes in Buckingham Palace Gardens and St James's Park are the places where the Westbourne surfaces in Westminster. Westminster sits above a regional chalk aquifer covered with gravels and clay. However, as would be expected in a dense highly urban environment much of the physical landscape is constructed of hard, non-porous materials. Figure 1 shows the geology of Westminster and its water features. Figure A-1 shows its general topography and Figure A-2 shows its heritage features (see appendix A).

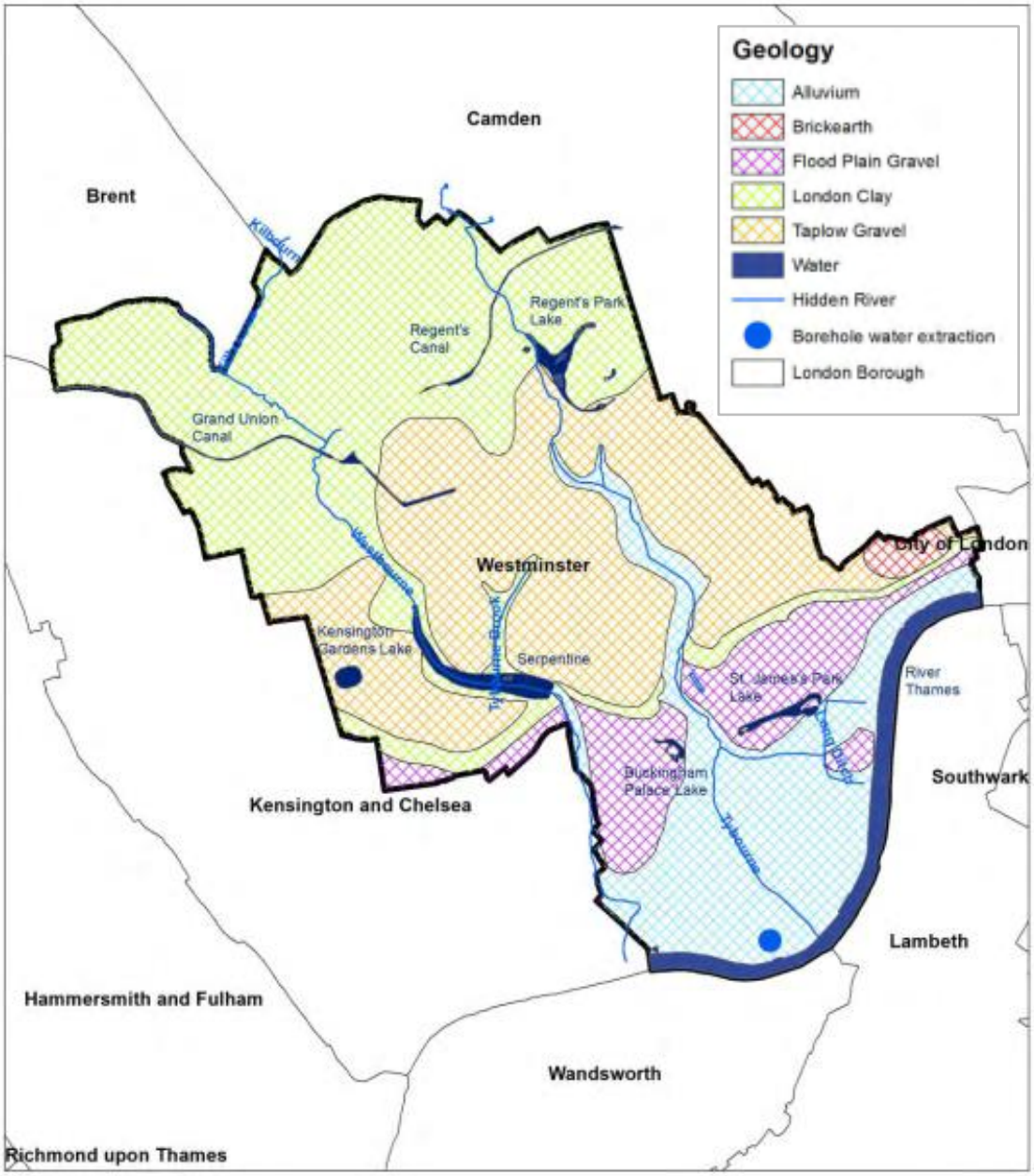

Figure 1: Geology

1.2.4 Westminster contains important national and local infrastructure. It has four of London's main line railway termini and 10 out of the 12 London underground lines. The network's busiest station, Victoria, which is used by approximately 75 million passengers a year, is located within Flood Zone 3.

1.2.5 Westminster has 4.7km of tidal Thames frontage, all of which has good protection against flooding by the (partly listed) Embankment wall. The Thames Barrier, downstream at Woolwich and the associated Thames Tidal Flood Defences provide a 1 in 1000 year standard of protection. Therefore discounting any breach in these defences, Flood Zone 3 in Westminster has an Annual Expected Probability (AEP) of flooding lower than 0.1%.

1.2.6 However, without these defences parts of Westminster could be flooded on a more regular basis. The Environment Agency's Flood Map for Planning (Figure A-3) has been prepared assuming that no tidal defences, including the existing Thames Barrier, are in place.

1.2.7 Flood Zone 3 comprises a substantial part of Westminster (17%) including Pimlico and Millbank, which contain well established residential communities and associated services, including shops and schools, and Victoria and Whitehall, which have a more commercial and governmental mixed use character respectively. The majority of land in Westminster (82.5%) is in Flood Zone 1, only 0.5% is in Flood Zone 2. This is comprised of a number of very small individual areas either on the boundary with Flood Zone 3 or scattered within it.

1.2.8 The risk of tidal and fluvial flooding within Westminster is assessed as being low. However, the residual risk of flooding following a failure of the flood defences should be considered as part of any plans for development within the Flood Zone 2 and 3 extents.

1.2.9 This SFRA identifies areas at risk of surface water flooding and drainage issues, including manhole surcharge, and takes account of Westminster City Council's Local Flood Risk Management Strategy and updated surface water flood risk modelling (WSP, 2023). It identifies how these risks can be appropriately managed, taking account of location, site opportunities, constraints and geology. The risk of reservoir failure in Westminster is also considered in this SFRA.

1.2.10 This SFRA shows that land available outside the flood risk areas is insufficient to accommodate all necessary development: development within areas potentially at risk of some form of flooding is therefore required. As such and to manage any potential flood risk for development, this SFRA provides the information required for the application of the 'Exception Test' where appropriate. It sets out details of flood risk in Flood Zone 3 according to flood probability, flood depth, flood velocity and rapid inundation zones.

1.2.11 This SFRA takes account of existing flood defences and the sequential, risk based approach to the location of development has been applied to ensure that areas at lower risk of flooding are developed in preference to those at higher risk. As development within the floodplain is generally considered sequentially acceptable in Westminster, this is mainly done through consideration of flood risk vulnerability and associated flood zone compatibility, in line with the Flood Risk and Coastal Change Planning Practice Guidance (PPG).

2 Relevant Legislation, Plans and Policies

2.1.1 Flood risk management is essential to ensuring sustainable development in all its elements, economic, social and environmental. It is also fundamental to delivering the Council's commitment to deliver the right kind of growth. The SFRA needs to be aligned with, and support development and delivery of, both local and national flood risk management plans. It does this by considering key legislation and international, national, regional and local plans and policies.

2.1.2 Relevant legislation, plans and programmes have been identified and considered in the preparation of this strategy. The key relevant plans are listed in Table 1 below.

2.1.3 The NPPF sets out the Government's planning policies for England and how these are expected to be applied.

Table 1: Relevant Legislation, Plans and Policy

National	The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019
	Water Environment (Water Framework Directive) (England and Wales) Regulations
	The Environmental Permitting (England and Wales) (Amendment) Regulations
	Environmental Assessment of Plans and Programmes Regulations 2004
	Conservation of Habitats and Species Regulations 2017
	Flood and Water Management Act 2010
	Flood Risk Regulations 2009
	National flood and Coastal Erosion Management (FCERM) Strategy for England 2021 (DEFRA)
	National Planning Policy Framework (NPPF) 2021 (MHCLG)
	National Planning Policy Framework Planning Practice Guidance, as updated in August 2022 (DLUHC and MHCLG)
	Non-statutory technical standards for sustainable drainage systems (DEFRA 2015)
Regional	The London Plan (2021)
	London Sustainable Drainage Action Plan (2015)
	The Mayor's Water Strategy 2011
	The Mayor's Climate Change Adaptation Strategy 2011
	Thames Estuary T2100 (2022)
	Mayor of London's Sustainable Design and Construction SPG (April 2014)
	London Regional Flood Risk Appraisal (Greater London Authority 2018)
	Thames River Basin Management Plan 2021
	London City Resilience Strategy (2020)
	London Environment Strategy (2018)
	London Resilience Partnership Strategic Flood Response Framework (2020)
	London Resilience Partnership Risk Register (2022)
Local	City of Westminster draft Surface Water Management Plan 2011
	City of Westminster Preliminary Flood Risk Assessment 2011
	City Plan 2019 – 2040 (2021)
	City of Westminster updated surface water modelling (WSP, 2023)
	City of Westminster Local Flood Risk Management Strategy 2017-2022 (2017)
	City of Westminster Environmental Supplementary Planning Document (2022)
	Westminster Climate Emergency Action Plan (2021)
	Westminster Multi Agency Flood Plan (2023)

3 Flood Risk in Westminster

3.1 Sources and History of Flooding in Westminster

3.1.1 Although rivers and the sea are the principle causes of flood damage in England, a significant proportion of flooding results from other sources. The following section provides information on the sources of flood risk within Westminster which include:

- Fluvial (river);
- Tidal (the sea);
- Surface Water;
- Sewers;
- Groundwater;
- Canals; and,
- Reservoirs.

3.2 Flooding from Fluvial and Tidal Sources (River Thames)

3.2.1 The Environment Agency Flood Map for Planning for Westminster is shown in Figure A-3. The Flood Zones designated on this map and as defined in the NPPF and associated Flood Risk and Coastal Change Planning Practice Guidance, are as follows (Table 2):

Table 2: NPPF Flood Zone Definitions

Flood Zone 1 – Low Probability	This zone comprises land assessed as having less than a 0.1% (1 in 1,000) annual probability of river or sea flooding in any year (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Flood Zone 2 – Medium Probability	This zone comprises land assessed as having between a 1% (1 in 100) and 0.1% (1 in 1,000) annual probability of river flooding (1% - 0.1%) or between a 0.5% (1 in 200) and 0.1% (1 in 1,000) annual probability of sea flooding in any year (Land shown in light blue on the Flood Map)
Flood Zone 3a – High Probability	This zone comprises land assessed as having a 1% (1 in 100) or greater annual probability of river flooding or a 0.5% (1 in 200) or greater annual probability of flooding from the sea in any year (Land shown in dark blue on the Flood Map)
Flood Zone 3b – Functional Floodplain	This zone comprises land where water from rivers or sea has to flow or be stored in times of flood.

***Note:** The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding.*

3.2.2 The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences.

3.2.3 Westminster sits on the north bank of the Tidal River Thames and is therefore potentially susceptible to both tidal and fluvial flooding. Operationally the River Thames Tidal Flood Defences within Westminster are sea defences and have a tidal designation in terms of the NPPF. The Thames is the only river in Westminster, as other watercourses (the hidden rivers mentioned in Section 1.2.3) have been subsumed into the sewerage network, with the

exception of the Serpentine in Hyde Park and St James's Park Lake (managed by the Royal Parks), which are locations where the River Westbourne comes above ground.

3.2.4 The main sources of info on potential tidal flooding of the Thames at Westminster are:

- **The Environment Agency's Flood Map for Planning:** Flood Zones as defined in Table 2.
- **Thames Estuary 2100:** for in-channel flood levels for the tidal River Thames.
- **The Thames Tidal Upriver Breach Inundation Assessment (May 2017)**: This study has built upon previous breach modelling studies using updated tidal water levels to ensure consistency with the TE2100 plan. Modelling results are available for the present day (2005) and 2100 scenarios.

3.2.5 Westminster, like many historic urban centres, no longer has a functional floodplain. Flood Zone 3b has been developed over the centuries and most recently by the Grosvenor Waterside Development scheme (formerly the Gatliff Road Depot site). Flood Zones 3a and b are, therefore, referred throughout this SFRA as Flood Zone 3.

3.2.6 Flood Zone 2 consists of a small number of individual areas and the SFRA does not provide specific advice for this zone. Planning applications received for schemes in these areas will be subject to the requirements of the NPPF.

3.2.7 The tidal and fluvial flood risk is Low due to the standard of protection offered by the Thames Barrier and associated Thames Tidal Flood Defences. However, flooding from rivers and the sea can occur in several ways, known as residual risks as discussed below.

Residual Flood Risk

3.2.8 The NPPF Flood Risk and Coastal Change Planning Practice Guidance states that residual flood risk comes in two main forms – from flood risk management infrastructure and to a development once any site-specific flood mitigation measures are taken out. Examples of residual risk from flood risk management infrastructure include breaching or overtopping defences. Examples of residual flood risk to a development include depths of internal flooding predicted after raising floor levels or the flood hazard to which people would be exposed on the access route.

3.2.9 As part of the TE2100, a Thames Tidal Upriver Breach Inundation Assessment (May 2017) has been carried out by the Environment Agency. Hydraulic modelling was carried out for the entire length of the tidal River Thames between Teddington Lock and the Thames Barrier to consider the impact of flooding should failure of defences occur. The breach modelling was undertaken for the 'Maximum Likely Water Level' (MLWL), this was calculated based on the maximum water levels allowed upstream of the Thames Barrier, based on the barrier operating under the current closure rules. The modelling was run for two points in time; 2005 and 2100.

3.2.10 The Thames tidal defence line was used to define the breach locations. It was assumed that the breach length for hard defences was 20m and 50m for soft defences. This resulted in 249 potential breach locations within Westminster; some of these are not at risk of breaching due to the local topography being above the MLWL.

3.2.11 Figure A-5 shows the maximum extent of flooding that may occur from breaching of the River Thames flood defences at present, and Figure A-6 to Figure A-8 show more detailed modelling results of maximum flood depth, velocity and hazard (present day). The flood hazard mapping combines water depth, velocity and debris to calculate hazard areas.

3.2.12 The modelling also includes information on the time to inundation from tidal breaching which has been used to develop Rapid Inundation Zones (0-30 minutes and 31-60 minutes)

consistent with previous SFRA. The Rapid Inundation Zone for Westminster is shown in Figure A-9.

History of flooding from fluvial and tidal sources

3.2.13 On January 6th 1928 a tidal surge, at high tide, came up the River Thames Estuary resulting in the flood defence walls and embankments, of the time, being overtopped. The extent of the flood area is shown in Figure A-4. Most of the 14 fatalities in Westminster occurred in basement dwellings in Millbank.

3.2.14 There was also a major tidal flood event in 1953 which affected the east coast of England and the Thames Estuary. Although this did not have significant impacts on Westminster itself, it did cause considerable damage in East London, rendering almost 200 people homeless in Canning Town and resulting in one death. Across the UK as a whole it caused 224 deaths and £50 million of damage (equivalent to about £1.3 billion today). The recognition following these events that a similar surge tide that affected central London could be 'a disaster of the singular and immense kind...a knock-out blow to the nerve centre of the country'[2] was the catalyst for the construction of the Thames Barrier and associated defence improvements through the 1970s and 1980s.

Likely impact of Climate Change

3.2.15 Climate change is predicted to have a major impact on future flood risk. For Westminster, the potential impacts of climate change are most significant in relation to tidal and surface water flooding.

3.2.16 Tidal flood risk in Westminster is controlled by the Thames Barrier and associated Thames Tidal Flood Defences. The levels of the River Thames, upstream of the barrier, including in Westminster, are the highest levels permitted by the operation of the Thames Barrier. If levels and flows are forecast to be any higher, the Thames Barrier would shut, ensuring that the tide is blocked and the river maintained to a lower level. For this reason, water level upriver of the Thames Barrier is controlled and therefore any associate return period becomes irrelevant.

3.2.17 The TE2100 in-channel levels take into account operation of the Thames Barrier when considering future levels. The Thames Barrier requires regular maintenance and with additional closures the opportunities for maintenance will be reduced. When this happens, there will be some higher tidal levels that the barrier cannot be shut for and therefore levels upriver of the Thames Barrier will increase and the tidal walls will need to be heightened to maintain the same standard of protection.

3.2.18 The TE2100 plan sets out the strategy for managing flood risk in the short, medium and long term as:

- **Phase 1a (2012 - 2022):** decide how to manage defences and maintain defences to required standards and prepare to adapt them in the future.
- **Phase 1b (2023 – 2035):** Develop visions for future riversides, including upgraded defences, more wildlife habitat and better access for the public; plan for defence upgrades; maintain defences to required standards.
- **Phase 2 (2035 – 2050):** Upgrade defences in line with visions for future riversides, taking a carbon net zero approach and enabling climate resilient growth; decide on an option for the future of the Thames Barrier (the end-of-century option) by 2040).

[2] H. Bondi (1967) London Flood Barrier, Report to the Ministry of Housing and Local Government.

- **Phase 3 (2050 – 2100):** put in place the preferred option for the future of the Thames Barrier by 2070; make further upgrades to flood defences before the year 2100.

3.2.19 For the London City policy unit, including Westminster, TE2100 states a commitment to maintain and even improve flood protection under the P5 policy, which is to " *take action to reduce the risk of flooding*". Specifically, the Environment Agency states that they are working with councils and landowners to identify upgrades required to prepare for sea level rise.

3.2.20 The Thames Tidal Upriver Breach Inundation Assessment (May 2017) has considered the impact of climate change on tidal breaching of the Embankment Wall flood defences. These have been assessed for 2100 using the tidal water levels defined by the Thames Estuary 2100 project. Figure A-10 shows the predicted extents of tidal breaches for Westminster from the River Thames in 2100.

3.3 Flooding from Surface Water

3.3.1 Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter drainage systems, because of blockages, or breakages in water pipes or where the drainage capacity has been exceeded. Due to the highly built-up nature of Westminster and its limited drainage capacity, surface water flooding is the most likely cause of flooding within Westminster.

3.3.2 Increasing rainfall and intensity of rainstorms due to climate change is likely to increase surface water flooding in Westminster in the future. Climate change is also likely to increase the frequency of severe droughts, exacerbating the risk from surface water flooding where very dry ground will be unable to absorb water resulting in increased runoff.

3.3.3 All parts of Westminster may be susceptible to varying degrees of surface water flooding. However, surface water run-off invariably pools in low lying areas with greater risk of surface water flooding.

3.3.4 The design of buildings can also contribute to localised surface water flooding. Developments with large roof areas e.g. Westminster's four main line railway stations, underpasses or low lying land can be especially vulnerable. In addition basement dwellings that are common in Westminster are vulnerable to flooding from surface water runoff.

3.3.5 Localised flooding of roads can also take place when gullies are unable to discharge into already full 'combined sewers', sewers which receive both foul water and water from roofs, hard standing and highways. It is often difficult to identify the source of the problem as it can be exacerbated by blocked gullies from debris.

3.3.6 The Mayor's Climate Change Adaptation Strategy for London 2011 recognises that there is a high probability of surface water flooding, particularly with increases in the volume and intensity of rainfall, the increased hard-surfacing of the urban landscape and ever more limited drainage and sewer capacity. The Mayor created a partnership of organisations responsible for surface water flooding in 2007, known as the Drain London Forum. This forum undertook strategic assessment of surface water flood risk in London. Westminster City Council continues its participation in similar forums.

History of flooding from surface water

3.3.7 The Westminster Preliminary Flood Risk Assessment (Halcrow, 2011) identified five incidents of historic surface water flooding in Westminster. These include closure of Westminster and Victoria underground stations, highway flooding and property flooding on Dorset Street.

3.3.8 Of the major surface water flood events which occurred across London and the surrounding areas in 2021, two particularly impacted Westminster on the 12th and 25th July 2021. Across the two events approximately 250 properties were affected with the majority of properties affected during the 12th July flood event across Westminster (Figure A-11). A Section 19 Flood Investigation Report has been undertaken by Westminster City Council, as well as an Independent London Flood Review to understand the flooding mechanisms. The findings confirmed that the amount of rain that fell during the two storms was the main cause of flooding, overwhelming the surface water and sewerage drainage systems. The review highlighted key recommendations for both Thames Water and Westminster City Council in order to deal with future flood events that may occur.

Surface water modelling

3.3.9 The surface water flood risk modelling process started with Drain London, the GLA programme to improve understanding of surface water flood risk in Greater London. Drain London resulted in the delivery of Preliminary Flood Risk Assessments and Surface Water Management Plans for each London Council. This process helped to provide a consistent baseline assessment of surface water flood risk across London. This information was used to determine the Critical Drainage Areas within Westminster.

3.3.10 Subsequently, in 2014, Westminster City Council commissioned WSP to undertake enhanced surface water modelling in Westminster using a Thames Water Sewer model. The study identified those areas most at risk from surface water flooding and where resources should be focussed in the future. This was then updated in 2015 using a calibrated Thames Water sewer model, which provided the evidence base necessary to secure funding to develop business cases for flood risk management schemes in the most at risk areas (Westminster Initial Assessment Study, 2015).

3.3.11 Following the 12th and 25th July 2021 flood events which were caused by a combination of overwhelming the surface water and sewerage drainage systems, Westminster City Council commissioned WSP to update and verify the 2015 enhanced surface water modelling using the latest Beckton Sewer model provided by Thames Water. This modelling has been validated against the 12th July 2021 event, as this had the greatest impact on the Westminster area. The results of this modelling are included within this SFRA, and have been used to inform the assessment of flood risk across the borough.

3.3.12 Figure A-12 shows the risk of surface water flooding across Westminster from the City of Westminster updated surface water modelling (WSP, 2023) in a 3.33% AEP rainfall event with tide locking and Figure A-13 shows the risk of surface water flooding in a 1% AEP rainfall event with tide locking.

3.3.13 Any development proposals within an area shown to be at risk of flooding from surface water as shown in the City of Westminster updated surface water modelling (WSP, 2023) should include details of how this risk will be managed over the lifetime of the development.

3.3.14 Climate change is predicted to lead to an increase in the intensity of extreme rainfall which will lead to an increase in the risk of surface water flooding. Current guidance from the Environment Agency suggests that extreme rainfall intensity is likely to increase by between 20% and 40% over the next 100 years.

3.3.15 The City of Westminster updated surface water modelling (WSP, 2023) has considered the impact of climate change and tide locking on surface water flood risk. This has been assessed for a 40% increase in peak rainfall intensity in Figure A-14.

3.3.16 The risk of surface water flooding has also been assessed without tide locking, in Figure A-15 to Figure A-17. Figure A-18 and Figure A-19 show the flood extents with and without tide locking.

3.3.17 The previous Draft SFRA (2019) referenced surface water flood risk hotspots which were based on the initial model created for the draft Surface Water Management Plan and Preliminary Flood Risk Assessment. As explained above, this model has since been updated to include the most recent data, calibrated using the Thames Water Beckton Sewer model and validated against the 12th July 2021 flood event. The surface water flood risk hotspots have been superseded by the surface water management zones (Figure A-20) derived from the updated modelling and Thames Water sewer network data; development proposed within these zones will therefore require more detailed flood risk assessments.

3.4 Flooding From Sewers

3.4.1 The public drainage across Westminster consists of combined sewerage infrastructure which receives foul water, water from roofs, hard standings and highways. The combined sewerage infrastructure is owned and maintained by Thames Water.

3.4.2 During periods of heavy rain, the available capacity within these sewers can be exceeded. This can lead to surcharging from manholes or combined sewer overflow (CSO) into the tidal River Thames and its tidal tributaries. These overflow discharges of raw sewage into the River Thames affect water quality and biodiversity. Specialist barges are used to oxygenate the river to mitigate the impacts of combined sewer overflows on animals and plants.

3.4.3 Thames Water holds details of incidents of sewer flooding for individual property, either externally or internally. The London Regional Flood Risk Appraisal advises that foul sewer flooding is most likely to occur where properties are connected to the sewer system at a level below the hydraulic level of the sewage flow, which in general are often basement flats or premises in low lying areas (paragraph 122).

3.4.4 North of the River Thames, the combined sewers flow from west to east and all flows are treated at the Beckton Sewage treatment works in east London during normal operation. The City of Westminster's sewer system receives flows from the Royal Borough of Kensington and Chelsea to the west. The River Westbourne and River Tyburn have been historically culverted and now form part of the combined sewer network.

3.4.5 In 2015, Thames Water built the £21 million Maida Vale flood alleviation scheme. New sewers were constructed on Chippenham Road and Formosa Street. The scheme increased the capacity of the sewerage network to cope with a 1 in 30 year storm event and aimed to protect 102 properties from sewer flooding in a 1 in 30 year rainfall return period. Maida Vale and West Kilburn are served by an approximately 2m diameter trunk sewer (Ranelagh trunk sewer) and the north-western storm relief sewer. A weir was installed at Formosa Street which directs flows into the throttle pipe and then into the trunk sewer during normal operation. In storm events when the trunk sewer is at capacity, flows back up over the drowned weir into a 20m diameter and 26m deep storage shaft located in Westbourne Green Park. After the duration of the extreme storm event flows are pumped back into the receiving sewer.

3.4.6 An additional overspill tank was constructed in Tamplin Mews Gardens as part of the Maida Vale flood alleviation scheme, over 15m diameter and 15m deep. Tamplin Mews disconnects properties along Shirland Road from the sewer system into a new sewer and storage tank. Flows are then pumped into the existing sewer system once there is capacity in the existing sewer system to accept the flows. The project was part of the £350 million scheme Thames Water spent across London and the Thames Valley to protect properties at risk from sewer flooding between 2010 and 2015.

3.4.7 Given the growth in development and strain on the existing system, even a relatively moderate rainfall can trigger an overflow in the combined sewers. During wet spells the sewers fill up with rainwater very quickly. Securing London's Water future -The Mayor's Water Strategy (October 2011) states that:

3.4.8 *'Widespread heavy rainfall can lead to over a million tonnes of untreated sewage and rainwater legally discharging directly into the rivers.'* (Chapter 6) The impact of climate change in terms of increasing intensity of rainfall would therefore have an adverse impact on flooding from this source.

3.4.9 As stated in Section 3.3, the 12th and 25th July 2021 flood events were caused by heavy rainfall, leading to a combination of overwhelming the surface water and sewerage drainage systems. The City of Westminster updated surface water modelling (WSP, 2023) has been validated by

the 12th July 2021 flood event to consider the impact of sewer flooding using the latest Beckton Sewer model provided by Thames Water.

3.4.10 Thames Water have created a sewer resilience programme to identify properties at highest risk of sewer flooding to install sewer flooding resilience measures such as FLIP devices (non-return valves and pumps) in their sewer connection. Thames Water have also outlined a number of actions that they will be focusing on following the flood events:

- Improve response to adverse weather warnings.
- Improve approach to customer service and ability to respond to contacts from customers.
- Improve ability to use data to better understand the impact of adverse weather.
- Improve communication with other stakeholders.
- Review and improve incident response processes.
- Improve on-site responses to flood events.

3.4.11 The Thames Tideway Tunnel, a nationally significant infrastructure project, is proposed to be the solution to CSO pollution incidents on the Thames by diverting CSOs into a new major sewer tunnel to be built beneath London and mostly beneath the River Thames. The Thames Tideway Tunnel is scheduled to open in 2025.

3.4.12 Fat, oil and grease are believed to contribute significantly to blockages in the sewer system and can cause overflow to properties and/or polluted watercourses. This can be a particular problem at locations where there are a number of food establishments located within a particular area, all draining into the same sewer system. This matter is particularly relevant in Westminster given there are some 3,000 restaurants, bars and cafes, many of which are clustered in the West End, including Soho, Covent Garden and Chinatown. Most food establishments are required to pay for the removal of used cooking oil (which increases the risk of this being tipped into the sewer system). Westminster City Council advises restaurant owners to make arrangements with specialist contractors to ensure this used cooking oil is removed from the premises.

History of flooding from sewers

3.4.13 Problems concerning sewerage flooding are a London-wide issue. Thames Water has maintained a database of sewer flooding incidents during the last 10 and 20 years (2002 – 2022); customers are required to contact them when sewer flooding events occurs, though it is possible that not all events may have been recorded. The records for Westminster are summarised in Table 3.

Table 3: Sewer Flooding Incidents

Postcode	At least 1 internal incident in last 10 years	At least 1 internal incident in last 20 years	At least 1 external incident in last 10 years	At least 1 external incidents in last 20 years
W9	10	8	0	0
W2	2	44	0	1
W1	8	442	2	1
SW1	2	738	1	0
NW1	4	76	0	0
NW6	2	0	1	0
NW8	0	0	0	0
WC2	0	4	0	0
SW7	0	0	0	0
SW3	0	50	0	0
Total	28	1,362	4	2

3.4.1 A burst water main can occur at any time and can have a serious impact on both property and infrastructure (including transport). In October 2007, as a result of a burst main at the junction of Maida Vale and St John's Wood Road, 20 businesses were flooded and water supplies to about 700 homes in Maida Vale were affected. In January 2012 a burst water main in Oxford Street, between Park Lane and Portman Street, resulted in flooding of 14 shops with millions of gallons of water causing damage and closure to the road near Marble Arch – loss adjusters estimated the cost of damage could run to £1m[3]. A second incident occurred in Regent Street, blocking shops and forcing road closures [London Evening Standard].

3.5 Flooding from Groundwater

3.5.1 The Flood and Water Management Act (FWMA) 2010 defines groundwater as 'all water which is below the surface of the ground in direct contact with ground or subsoil'. This water occupies the cracks and pores of permeable rocks, soils and gravels. LLFAs have responsibilities for local flood risk including groundwater under the FWMA 2010. The Act gives LLFAs duties to prepare local flood risk management strategies and to co-operate with other Risk Management Authorities, along with powers to implement its local flood risk management.

3.5.2 Groundwater springs from the ground at the point where the water table meets the surface. This type of flooding is likely to occur in low-lying areas which are underlain by permeable rock (aquifers). The risk of groundwater flooding in Westminster is considered to be low; although

[3] BBC News (2012) Oxford Street burst water main repaired. Available from: https://www.bbc.co.uk/news/uk-england-london-16665128 [Accessed 27 March 2023]

Westminster sits above a regional chalk aquifer, this is covered with gravels and clay which are more impermeable.

3.5.3 Water that starts as groundwater can flow into rivers and drainage networks, resulting in flooding from rivers and surface water. This emphasises the need for LLFAs and other risk management authorities, including Thames Water in Westminster, to work together to manage this risk. Managing groundwater flooding is not easy because it is hard to predict and model accurately, and the impacts of flooding can be dispersed over large areas. In the event of a Groundwater flooding incident LLFAs should contact the Environment Agency through established links for flood risk response.

3.5.4 Underground development is common in Westminster and there are a number of underground stations and basements that require pumps to remove excess groundwater to prevent flooding.

3.5.5 The British Geological Survey (BGS) have produced a groundwater flooding dataset, which is an update to the previously produced 'susceptibility of groundwater flooding' dataset. It identifies vulnerability to groundwater flooding on a 1km square grid and has been used to identify vulnerability to groundwater flooding within Westminster by calculating the number of 1km squares within a parish/ward which fall within the different percentage classifications of vulnerability. It must be noted that due to the level of confidence in the dataset this map should only be used to identify broad areas (rather than individual properties) which are vulnerable to groundwater flooding and hence may need further investigation for more detailed assessments.

3.5.6 Due to the uncertainties in groundwater mapping and as maps indicate where groundwater emergence is possible (and not areas where groundwater flooding is predicted), it is recommended that the mapping is used in conjunction with anecdotal evidence of groundwater flooding where possible.

3.5.7 Areas with increased potential for elevated groundwater are shown in Figure A-21. These indicate where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or to be within 2 m of the ground surface. This modelling indicates that elevated groundwater from permeable superficial soils are located around Marylebone, Kensington Gardens, Mayfair and Belgravia with sporadic pockets towards the southern end of the borough.

3.5.8 Within the areas delineated as having increased potential for elevated groundwater, the local rise of groundwater will be heavily controlled by local geological features and artificial influences (e.g. structures or conduits) which are not currently represented.

3.5.9 Like other forms of flooding, groundwater flooding is affected by increased levels of rainfall, which are anticipated to increase in the future. The Mayor's Water Strategy (October 2011) states that:

> *"Following prolonged periods of rainfall, groundwater flooding can typically last weeks, and tends to happen late in the winter when groundwater levels reach a peak ". (paragraph 5.3.3)*

3.6 Flooding from Canals, Water Features and Water Mains

3.6.1 In Westminster this type of flooding is most likely to result from a burst main; and /or infrastructure failure in an artificial watercourse or water bodies i.e. canals or other water features.

3.6.2 Water mains run below all of the built areas of Westminster and many of these date from Victorian times. Detailed records are held by Thames Water. Information can be found at the following website: http://www.thameswater.co.uk/.

3.6.3 There are a number of canals and water bodies in Westminster, these include:

- Paddington Branch of Grand Union Canal, including Paddington Basin and Little Venice;
- The Regent's Canal;
- Serpentine Hyde Park (Reservoir);
- Regent's Park Lake;
- St James's Park Lake;
- Kensington Gardens Lake; and,
- Five 'hidden rivers ', the Westbourne, Tyburn, Tyburn Brook, Kilbourne and Long Ditch, which are now all culverted.

3.6.4 Canals are the responsibility of the Canal and River Trust. They can be contacted via the following website: www.canalrivertrust.org.uk. The Serpentine, St. James's Park Lake and Regent's Park Lake are located within the Royal Parks http://www.royalparks.org.uk/.

3.6.5 The Serpentine is a designated Reservoir and is subject to the requirements of the Reservoirs Act 1975 and Flood and Water Management Act 2010. As the Serpentine sits within Hyde Park (a Royal Park), in the event of an infrastructure failure/breach a Reservoir Inundation Plan will be initiated by the Royal parks; this role is recognised in the Westminster City Council multi-agency flood plan.

3.6.6 The multi-agency flood plan indicates that any flood risk Incidents without a clear confirmation of the source of flooding will be investigated and relevant parties responsible for managing the flood response will be notified.

3.6.7 It is not anticipated that there will be any impact of climate change on flooding from infrastructure failure.

3.6.8 The Environment Agency have produced reservoir flood maps (Figure A-22) which show where flooding may occur in the event of a reservoir failure. There are 2 flooding scenarios shown on the reservoir flood maps: a 'dry-day' and a 'wet-day'. The 'dry-day' scenario predicts the flooding that would occur if the reservoir failed when rivers are at normal levels. The 'wet day' scenario predicts how much worse the flooding might be if a river is already experiencing an extreme natural flood. The mapping does not indicate the likelihood or probability of reservoir flooding.

3.6.9 The areas affected from this type of flooding would mainly be localised to the source of the flooding i.e.

- Canals: Paddington Branch of the Grand Union Canal, including Paddington Basin and Little Venice; and Regent's Canal (also part of the Grand Union Canal).

- Water Features: Serpentine (Hyde Park - Reservoir); Regent's Park Lake; St. James's Park Lake; Kensington Gardens Lake (Round Pond); Buckingham Palace Gardens Lake; and 'Hidden Rivers'.

3.6.10 The Grand Union and Regent's Canals in Westminster present minimal flood risk as they have limited surface water inputs and none of the canals to our knowledge are on embankments. There are no canal locks within Westminster itself, the closest lock is to the east at Hampstead Road, which is the first of several locks through Camden. Any malfunction to the east of Westminster would cause the water to flow east, not into Westminster. To the west, the level of the canal starts to rise at Cowley lock, which is near the M25 and located 16 miles from Westminster.

3.6.11 The Grand Union Canal lies alongside and crosses between the River Colne Valley and the River Lee Navigation which are linked to large fluvial catchments, however any flooding in these areas will not impact on The Grand Union Canal given they are at a lower level than Westminster.

3.6.12 The Serpentine, the lakes in Buckingham Palace Garden and St James's Park are the remnants of the 'hidden' rivers in Westminster. Although the 'hidden' rivers themselves appear to have sufficient capacity, any water features they serve are susceptible to flooding.

3.6.13 Good management of the infrastructure itself is the key to minimising the threat of flooding from these sources.

3.6.14 The Canal and River Trust operate management regimes throughout the canal systems to help manage water levels and reduce flood risk. Their Asset Management Policy (2021)[4] details how they will manage all infrastructure assets that enable access to, and use and enjoyment of, waterways and towpaths through inspection, monitoring, maintenance, refurbishment and renewal of existing assets and the acquisition or design and installation of new assets to enhance the waterways and towpaths.

3.6.15 In London, the Canal and River Trust undertakes inspections of waterways track on monthly or three monthly cycles. Inspectors note changes in the condition of assets and waterway track. Any changes in condition brought about by natural wear and tear, accidental damage, natural occurrences, vandalism, third party works or anything else that may affect the track is noted. Inspections on the towpath side are undertaken monthly and standards are set out in the Assets Inspection Procedure. The most recent Asset Management Strategy (2018) is available on the Canal and River Trust website[5].

3.6.16 The Thames Water mains water distribution network covers nearly 20,000 miles and, dating from Victorian times, is the oldest network in the UK, with an average age of about 70 years. Two-thirds of their water mains have been in use for more than 50 years. Thames Water outlines their plans to improve their distribution network in order to reduce leakage and the risk of burst mains. This is set out in their Business Plan for 2020 to 2025[6]and their Drainage and Wastewater Management Plan 2025 - 2050[7].Thames Water will make use of latest technology to monitor and manage the performance of their system and to reduce losses of water. Information from 'smart' meters will help target key locations to improve performance. Improved knowledge of deterioration rate of trunk mains and improved monitoring will help, to better predict and prevent these bursts.

[4] https://canalrivertrust.org.uk/media/original/33904-asset-management-policy-2021.pdf?v=d2eac8
[5] https://canalrivertrust.org.uk/specialist-teams/maintaining-our-waterways/asset-management
[6] https://www.thameswater.co.uk/media-library/home/about-us/regulation/our-five-year-plan/view-our-plan/building-a-better-future.pdf
[7] https://www.thameswater.co.uk/about-us/regulation/drainage-and-wastewater-management

3.7 Flood Risk Management Infrastructure

3.7.1 The River Thames floodplain is defended by over 330km of flood walls, embankments, and nine tidal barriers, including the Thames Barrier. As well as this, there are over 400 other structures including flood gates, outfalls and pumps which offer protection against a tidal flood event that has a 0.1% AEP of occurring up to the year 2030. The Thames Barrier and associated Thames Tidal Flood Defences provide a very high level of protection against river and tidal flooding, 1 in 1000 year standard of protection. The operation of the Thames Barrier and the associated gates is managed by the Environment Agency and is governed by the Thames Barrier and the Flood Prevention Act 1972.

3.7.2 The Environment Agency uses information from weather satellites, oil rigs, weather ships and coastal stations to forecast potential tidal surges. This information comes from models forecasting expected sea and river levels, supplemented by Meteorological Office data and real-time information from the UK National Tidegauge Network. Tides are tracked with dangerous conditions forecast up to 36 hours in advance. The barrier will be closed just after low tide, or about 4 hours before the peak of the incoming tide surge reaches the barrier. The decision to close the Barrier, or not, is made based on the following:

- The height of the tide (usually a spring tide) measured at the Thames Estuary;
- The height of the tidal surge; and,
- The fluvial flow entering the tidal Thames, as it passes over Teddington Weir.

3.7.3 The Thames Barrier spans 520m across the River Thames, protecting 125km^2 of central London from flooding caused by tidal surges. It takes approximately 1.25 hours to close all 10 gates and creates a ‘sufficiently empty’ reservoir for fluvial flow entering the tidal Thames, at Teddington Weir, to be stored. The Thames Barrier will remain closed over the high tide period until the water level downstream is equal to the water level upstream, which takes about 5 hours. The Thames Barrier is then opened to allow the water upstream to flow out on the ebb tide.

3.7.4 The Environment Agency data below (Figure 2) shows the barrier has been closed 205 times to prevent flooding in its history up to February 2022, with over 50 of the closures in the winter of 2013/14.

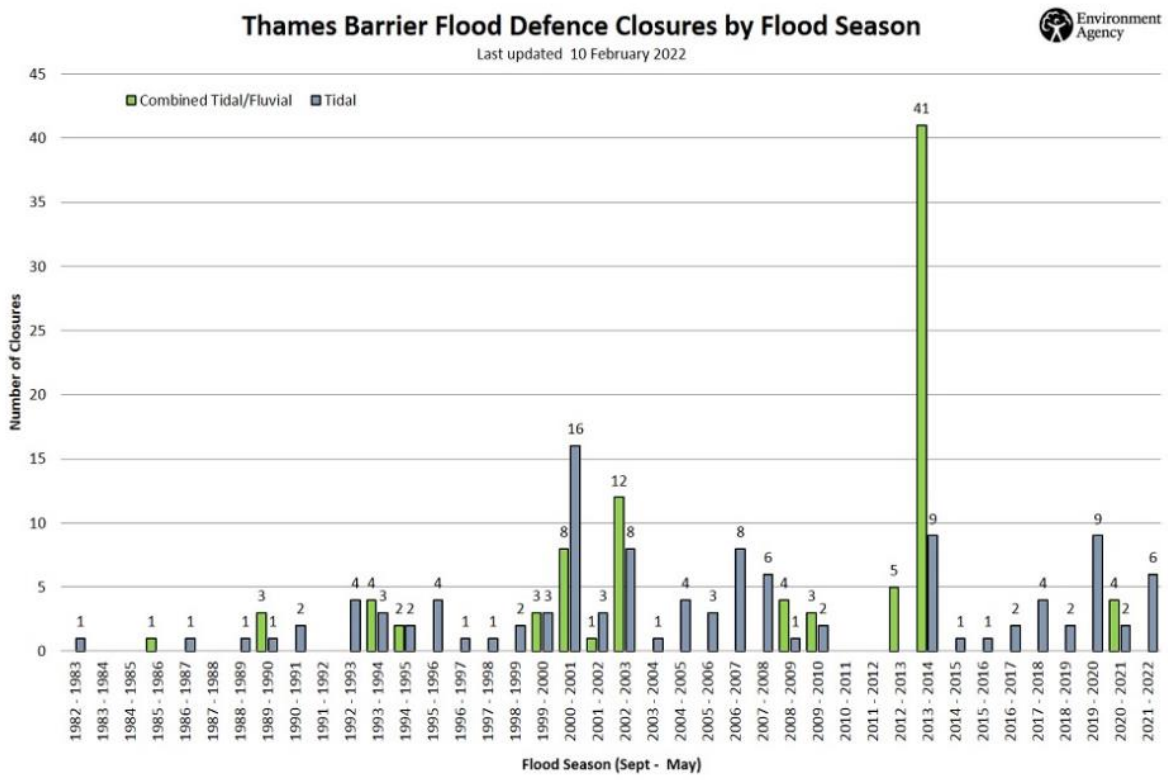

Figure 2: Thames Barrier Closures

3.7.5 Due to the predicted rise in sea level and increase in peak river flows as a result of climate change, closure of the barrier is likely to become more common. The Environment Agency has indicated that if the barrier is closed 50 times a year on average or more, new tidal flood defences for the Thames Estuary will need to be put in place.

3.7.6 Westminster is also defended from tidal and fluvial flooding by the Embankment flood wall. This was constructed between February 1864 and July 1870 by Sir Joseph Bazalgette. It was constructed of brick walls faced with granite and to a depth of 33ft below the high water mark.

The Thames Barrier

3.7.7 The Thames Estuary 2100 (TE2100) plan states that the Thames Barrier is expected to remain viable until 2070 (under current climate change predictions). This means that for the first 25 years (2010 to 2034) the Environment Agency's plan is to continue managing tidal flood risk through actively maintaining and improving the existing system, combined with multi-agency floodplain management (including setting development back from the river and directing vulnerable development away from high flood risk areas) and an intertidal habitat replacement programme. This will continue, with more major renewal and replacement of defences.

3.7.8 Between 2035 and 2050, the plan is to determine the preferred option for the future of the Thames Barrier. Around 2050, a decision will need to be made on the plan for the end of century, since planning, design and construction must start soon after this time to ensure that by 2070 new arrangements are in place. On the basis of the TE2100 appraisal, the two 'front runner' options are either continuing to upgrade and modify existing flood defences and floodplain management (Option 1.4),or constructing a new barrier at Long Reach with associated works (Option 3.2). However this may change as the TE2100 plan is reviewed every

10 years. The TE2100: 10-year Review monitoring key findings were published in September 2022 and other technical studies are currently being carried out, including a review of how much allowance to include in flood defence design to account for uncertainty on extreme wave heights and updating modelling of how water moves up the estuary during a storm tide. The results of these studies will update the Plan's deadlines for upgrading the tidal flood defences. Westminster City Council will continue to update its flood risk advice based on changes to flood risk management infrastructure.

The Embankment Wall

3.7.9 Most of the Embankment is listed (Figure 3). North of Westminster Bridge the Victoria Embankment is grade II listed. The Embankment wall is also grade II listed at Victoria Tower Gardens between the Houses of Parliament and Lambeth Bridge. To the south of Lambeth Bridge the River Thames embankment adjacent to Victoria Tower Gardens, Millbank, Riverside Walk and Grosvenor Road is unlisted – unless it is part of associated listed buildings.

Figure 3: The Embankment Wall

3.7.10 The responsibility of repair and maintenance to the Embankment wall is provided in Table 4 as follows:

Table 4: Responsibility of repair and maintenance of the Embankment Wall

Section of the wall	Who is responsible
Victoria Embankment and Wall (City of London boundary to Westminster Bridge)	Westminster City Council
Thames Embankment and Wall (Westminster Bridge to east of Lambeth Bridge)	Crown/Parliamentary Works
Thames Embankment and Wall (Lambeth Bridge to east of Vauxhall Bridge including Millbank Tower and Tate Britain)	Westminster City Council
Thames Embankment and Wall (Vauxhall Bridge to rear of 141 Grosvenor Road and rear of Pimlico Gardens)	Westminster City Council
Thames Embankment and Wall rear of 128-140 Grosvenor Road	Westminster City Council
Thames Embankment and Wall from 128 Grosvenor Road but not rear of it to the Royal Borough of Kensington and Chelsea boundary	Owners/Crown Estate
Westminster City Council is responsible for maintaining the section of river wall immediately west on Vauxhall Bridge as part of its lease agreement for the small park garden	Owned by Crown Estate but leased by Westminster City Council until around 2065.

3.7.11 In light of the consequences of a breach in the Embankment wall, the following recommendations were made in the 2010 SFRA regarding inspection and maintenance.

- "In addition to the regular structural surveys carried out along the whole Westminster tidal defence, more emphasis is paid to the structural condition of tidal defences along the four critical reaches"
- "Priority funding, maintenance is given to the tidal defences along the critical reaches".

3.7.12 The critical reaches of the Embankment wall are at:

- Tate Britain, Millbank;
- Grosvenor Road, Pimlico;
- Between Lambeth Bridge and Westminster Bridge; and,
- Victoria Embankment (from Richmond Terrace to Horse Guards Avenue).

3.7.13 As an overall strategy for maintenance of local flood defences, Policy SI 12F (Flood Risk Management) of The London Plan advises that development adjacent to existing flood defences must protect their integrity and wherever possible should be set back from the banks of watercourses to allow for the management, maintenance and upgrading of defences to be undertaken in a sustainable and cost effective way. The establishment of the Embankment in the nineteenth century and associated legislation which precluded development in close proximity to it has dictated the existing landscape of this area. Therefore, much of Westminster's riverside frontage is set back from the Embankment Wall by at least the width of Grosvenor Road.

3.7.14 Westminster City Plan Policy 35G (Flood Management Infrastructure) ensures that all existing flood management infrastructure is protected, including access for maintenance, with a 16m undeveloped buffer kept around defence structures where possible. Policy 35H ensures that any development should not limit future raising of flood defences as outlined in the Thames Estuary 2100 Plan. This approach to protect flood-related infrastructure and retain access for maintenance is a priority action in the Local Flood Risk Management Strategy 2017-2022 (November 2017).

3.7.15 Within Westminster the key infrastructure for management of surface water is the combined sewer system that is operated by Thames Water. This captures rainfall from building roofs and ground surfaces which are then conveyed along with foul sewage to sewage treatment works east of Westminster.

3.7.16 Following the July 2021 flood events, Thames Water have created a sewer resilience programme to identify properties at highest risk of sewer flooding to install sewer flooding resilience measures, such as FLIP devices (non-return valves and pumps) in their sewer connection, to help prevent this from happening again. There are currently 268 properties which recently flooded and are being investigated for flood mitigation works, which could include FLIPs or other solutions. They have also outlined actions that they will be focusing on following the flood events, including improving response to adverse weather warnings, approach to customer service and communication, ability to use data and incident response processes.

3.7.17 In the future, the Thames Tideway Tunnel will divert and capture CSO discharges, which will then convey flows to the Beckton Sewage Treatment Works. The Thames Tideway Tunnel will provide part of the solution required to ensure compliance with the Urban Waste Water Treatment (England and Wales) Regulations 1994.

3.7.18 The Tideway Tunnel is not designed to reduce flood risk, however it will decrease the effects of tide locking from CSO discharges and so decrease the effects of tide locking on drainage during high rainfall events.

3.7.19 Thames Water as an infrastructure provider is anticipated to complete the building of the Thames Tideway Tunnel by 2024. Thames Water will also operate and maintain the tunnel.

3.8 Summary of Flood Risk

3.8.1 Fluvial and Tidal flood risk is effectively managed by the Thames Barrier and associate Thames Tidal Flood Defences; under normal operating conditions, there is only a residual risk of flooding due to a breach or failure of a portion of the flood defences.

3.8.2 Due to the heavily urbanised nature of Westminster, and the predominantly Victorian drainage infrastructure, there is a widespread risk of surface water flooding.

3.8.3 Flooding from sewers usually occurs due to blockages or material failure of the sewer network. Most of Westminster is served by combined sewers receiving foul and surface water, which are managed by Thames Water. They undertake a risk based management approach in their operation of the assets. The recent July 2021 flood events were caused by heavy rainfall, leading to a combination of overwhelming the surface water and sewerage drainage systems, demonstrating that sewer flooding is expected within Westminster with basement properties particularly vulnerable.

3.8.4 There is a low risk of groundwater flooding within Westminster, which could increase to a higher risk with the construction of below ground development (basement extensions etc.).

3.8.5 There is a residual risk of flooding due to the failure of either water mains or canals, the impacts of such a failure could be significant.

4 Sequential Test & Exception Test

4.1 Sequential Test

4.1.1 As discussed in the NPPF (paragraph 159) and PPG, inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, taking climate change into account.

4.1.2 Within Westminster, the only Tidal and Fluvial source of flooding is the River Thames; approximately 17% of the borough is located within Flood Zone 3 and only 0.5% located within Flood Zone 2.

4.1.3 As discussed in Section 3.7, Westminster benefits from significant Tidal Flood Defence infrastructure and under ordinary operational conditions, is not at risk of flooding from the Thames. It is considered appropriate to assess flood risk from tidal and fluvial sources within Westminster as Low, however some areas are considered at greater residual risk where located in a Rapid Inundation Zone (RIZ) as shown in Figure A-8. These areas will therefore require greater consideration of factors such as flood resilience and safe access and egress.

4.1.4 Surface water, sometimes associated with sewer flooding, is a recognised source of flood risk within Westminster. As shown in Figure A-12 to Figure A-19, potential flooding is possible in various parts of Westminster and recent flood events in 2021 are consistent with this. Avoiding areas at risk of surface water flooding is difficult however new development can be designed to mitigate any associated risk. In addition, all brownfield redevelopment provides the opportunity to reduce surface water flood risk locally in a sustainable way, by implementing Sustainable Drainage Systems (SuDS), and reducing the peak rate and volume of surface water run-off when compared to the baseline condition. Redevelopment within areas of existing surface water flood risk must include appropriate mitigation measures to reduce flood risk. Appendix C includes checklists for site-specific flood risk assessments and drainage strategies, which reference these mitigation measures.

4.1.5 Although there are a number of potential sources of flooding in Westminster, it is not practicable to apply the Sequential Test to differentiate potential development sites. There are several development pressures on Westminster due to the existing highly built form and shortage of land. Policy 8 of the City Plan identifies the housing need for Westminster, with the number of new homes built by 2040 to exceed 20,685. In order to achieve this target, it is necessary to fully optimise the delivery of new provision across Westminster, using land efficiently. Due to this shortage of options, some sites at risk of flooding will need to be considered.

4.1.6 Development in Flood Zone 2 and 3, and in areas at medium and high flood risk from all sources, will be considered although preference will be given to Flood Zone 1 and areas with no risk of flooding from all sources. Therefore proposals for development within Flood Zone 2 and 3 and in areas at medium and high flood risk from all sources will be generally deemed sequentially acceptable; however this will be subject to the criteria in Table 5 (which replicates Table 2 of the Flood Risk and Coastal Change PPG, 'Flood risk vulnerability and flood zone incompatibility') and meeting the requirements of the Exception Test, where applicable (e.g. residential development in Flood Zone 3).

4.1.7 In addition, self-contained basements or basement flats wholly or partially below ground, without freely available access to a habitable space above ground within the same dwelling are 'highly vulnerable' uses in accordance with Table 5. Westminster City Council's policy approach is to not allow these in high or medium surface water risk areas, Flood Zone 2, Flood Zone 3 or Rapid Inundation Zones.

4.1.8 Dwellings wholly or partially below ground with freely available internal access at all times to a habitable space above the maximum likely water level in case of a breach, are considered

'more vulnerable' and the Exception Test will apply to such sites. Within the Rapid Inundation Zones (presented in Figure A-8), such uses will not be acceptable.

4.2 Exception Test

4.2.1 Both elements of the Exception Test should be satisfied, where applicable, for development to be allocated or permitted. For the Exception Test to be passed:

a) Development that has to be in a flood risk area will provide wider sustainability benefits to the community that outweigh the flood risk; and

b) A site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

4.2.2 Table 5 summarises when the Exception Test needs to be passed as part of any Planning Application submission. It also shows which type of development is appropriate within each flood zone depending on its vulnerability.

Table 5: Development Types and Appropriate Flood Zone Designations

Vulnerability Classification	Development Types	Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Essential infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk	✓	✓	**ET**	**ET**
	Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood	✓	✓	**ET**	**ET**
	Wind turbines	✓	✓	**ET**	**ET**
	Solar Farms	✓	✓	**ET**	**ET**
Highly vulnerable	Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding	✓	**ET**	✗	✗
	Emergency dispersal points	✓	**ET**	✗	✗
	Basement dwellings	✓	**ET**	✗	✗
	Caravans, mobile homes and park homes intended for permanent residential use	✓	**ET**	✗	✗
	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')	✓	**ET**	✗	✗
More vulnerable	Hospitals	✓	✓	**ET**	✗
	Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels	✓	✓	**ET**	✗
	Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels	✓	✓	**ET**	✗
	Non–residential uses for health services, nurseries and educational establishments	✓	✓	**ET**	✗
	Landfill* and sites used for waste management facilities for hazardous waste	✓	✓	**ET**	✗
	Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan	✓	✓	**ET**	✗
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	✓	✓	✓	✗

Vulnerability Classification	Development Types	Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
	Car parks	✓	✓	✓	✖
Water compatible	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	✓	✓	✓	✓*

*In Flood Zone 3b (functional floodplain) essential infrastructure that 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.

5 Site-Specific Flood Risk Assessment Guidance

5.1 Overview

5.1.1 This section provides the requirements for site-specific flood risk assessments and surface water drainage strategies which should be submitted as part of planning applications to demonstrate that proposed developments are appropriately flood resilient and resistant.

5.1.2 Appendix B includes more detailed requirements for FRAs and surface water drainage strategies, including specific requirements for different types of applications, and should be used by applicants. Appendix C includes checklists for FRAs and surface water drainage strategies to accompany the guidance in this section and support both developers and planners in preparing and assessing submissions.

5.2 The Site-Specific Flood Risk Assessment

5.2.1 Site-specific Flood Risk Assessments (FRAs) will need to be prepared by prospective developers for specific development sites. These sites are the following:

- All development in Flood Zone 2 and 3 (including minor development, change of use and householder applications which would alter footprint or add levels);
- All development of more than 1 hectare;
- Development of less than 1 ha in Flood Zone 1, including a change of use in development type to a more vulnerable class (e.g. from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water flooding or reservoir flooding);
- All self-contained basement developments;
- All basement developments located within Flood Zone 2 and 3, or an area of surface water flooding (within a surface water management zone or within a surface water flow path in the 3.33% AEP event or above, identified in Figure A-12 to A-14) ;
- All development located within a surface water management zone (previously surface water flood risk hotspots) (identified in Figure A-20).

5.2.2 Site specific FRAs may be stand-alone documents submitted by the developer to accompany a planning application. In those instances where an Environmental Statement is required for a development the developer should ensure that the FRA is attached and inform the Environmental Statement.

5.2.3 Appendix B includes the specific requirements for FRAs to be provided with different types of planning applications; Appendix C includes an FRA checklist which must be completed and submitted with every FRA as part of a planning application.

5.2.4 The detail provided in the FRA should be based on up-to-date existing flooding information (e.g. Environment Agency's Flood Map for Planning, breach modelling results taken from the Thames Tidal Upriver Breach Inundation Assessment and history of flooding at the site) and be commensurate to the probability and associated risk of flooding for the proposed development taking into account the nature of the proposals: for example risk for a commercial property is generally lower than that for a residential development. Also, where the probability of flooding to the site is negligible there is little benefit to be gained in assessing the potential risk to life and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site is controlled safely and sustainably on-site and does not exacerbate flooding lower in the catchment.

5.2.5 Where appropriate, the scope of the FRA should be agreed with Westminster City Council. We recommend contacting the council at the following email address for flood risk and drainage related questions: LLFA@westminster.gov.uk.

5.2.6 Other statutory consultees should also be consulted - the Environment Agency and Thames Water. Those stakeholders will be able to provide useful background information to inform the assessment and the mitigation of flood risk through design. Some general recommendations are provided in the following pages. The FRA must demonstrate how flood risk will be managed for a proposed development, without increasing flood risk to the surrounding areas; any associated surface water drainage strategy should utilise SuDS, unless there are practical reasons for not doing so, to ensure the sustainable management of surface water runoff. Westminster will make their decision based on the evidence within the FRA as to whether the development is acceptable.

5.2.7 Those proposing development within Flood Risk areas should take advice from the Westminster City Council and the emergency services during the FRA process to understand whether a Flood Warning and Evacuation Plan (FWEP) is required as part of the flood risk mitigation strategy; where appropriate, a FWEP can be attached as an appendix to the FRA.

5.2.8 Developments proposed adjacent to the River Thames should follow the Estuary Edges[8] design principles, aimed at providing an ecological design guide for softening the riverside 'edges' to encourage natural wildlife into urban estuaries.

5.3 Tidal Flooding

5.3.1 The Tidal and Fluvial flood risk within Westminster is Low. However, some areas are at residual risk of flooding should a portion of the River Thames Tidal Flood Defences fail. Consequently, proposed developments within the defended Flood Zone 2 or 3, should confirm if the proposed site is at risk of flooding as a result of a breach of the defence within the FRA.

5.3.2 The Thames Tidal Upriver Breach Inundation Assessment has informed this SFRA and the recommendations made for development within the Tidal Breach Flood Extent (including the Rapid Inundation Zone) within Flood Zone 3.

Tidal Land Use Recommendations:

- In line with Policy 35D in the Westminster City Plan, sites within Flood Zone 3 are not suitable for Highly Vulnerable Uses. This includes: self-contained basement dwellings; police, ambulance and fire stations and command centres and telecommunications installations that would be required to be operational during flooding and emergency dispersal points.
- Development within Zone 2 and 3 might need to pass the Exception Test depending on vulnerability.
- Dwellings wholly or partially below ground with freely available internal access at all times to a habitable space above the maximum likely water level in case of a breach, are considered 'more vulnerable' and the Exception Test will apply to such sites. Within the Rapid Inundation Zones such uses will not be acceptable, including basements. This is included within Policy 35D of the Westminster City Plan.

[8] Thames Estuary Partnership (2023) Estuary Edges Design Principles. Available from: https://www.estuaryedges.co.uk/design-principles/

Tidal Evacuation Access and Egress Recommendations:

- An evacuation route to land outside of the floodplain should be provided if feasible. Where this is not possible, 'more vulnerable' developments and, where possible, development in general (including basements), should have internal stair access to a safe haven within the building to a level higher than the maximum likely water level. Such a haven should be sufficient in size for all potential users and be reasonably accessible to the emergency services.
- A FWEP is generally required for 'more vulnerable' development within the areas at risk of tidal breach flooding, especially if the land use is within the Rapid Inundation Zone; it is recommended to discuss specific requirements with Westminster City Council Emergency Planning Team. This should include sign up to the Environment Agency's Flood Warning Direct service and procedures for acting on a Flood Warning received, including evacuation procedures from the building.

Tidal Level of Floors and Thresholds/Openings Recommendation: Ground level of new 'more vulnerable' developments (e.g. residential dwellings) within the modelled tidal breach flood extents, should be above the maximum likely water level (this level will be site specific). The same applies to thresholds into basements (e.g. basement car parks) if feasible.

Tidal Property Flood Resilience Recommendation: Property Flood resilience (PFR) measures should be considered in the areas at risk of tidal breach flooding where appropriate; this depends on the level of risk and the nature of the proposals and can help in minimising the consequences of flooding and facilitating the recovery from the effects of flooding sooner than conventional buildings. PFR measures should be considered also for basement development within Flood Zone 2 and 3.

PFR could include:

- **External walls**: careful consideration of materials using low permeability materials to limit water penetration (avoiding using timber frame and cavity walls). Consider applying a water-resistant coating.
- **Windows**: flood resilient windows if they are to be located below the maximum water level expected. These windows should be watertight and be able to withstand the high pressure exerted on them when submerged under flood water (and the debris contained in the water).
- **Air vents**: should not be located below the maximum water level expected.
- **Internal walls:** avoid the use of gypsum plaster and plasterboard at the lower ground level; use more flood resistant linings (e.g. hydraulic lime, ceramic tiles). Avoid use of stud partition walls.
- **Fitting, fixture and services:** if possible, locate all fittings, fixtures and services above the maximum water level expected to minimise damage by flood waters. Avoid chipboard and MDF (Medium Density Fibreboard). Consider the use of removable plastic fittings. Use solid doors treated with waterproof coatings. Avoid fitted carpets. Locate electrical, gas and telephone equipment and systems above design flood level.
- **Drainage systems and pipes:** Fit anti-flooding devices to drainage systems to prevent surcharged flooding through toilets. These devices act as one-way valves, preventing contaminated flood water backing up into the buildings through the toilets.

5.4 Surface Water Flooding

5.4.1 With the introduction of the Flood and Water Management Act in 2010, responsibility for local flood risk management including surface water runoff, groundwater and flooding from ordinary watercourses (smaller rivers and streams), was passed to Lead Local Flood Authorities, of which Westminster City Council is one. A draft Surface Water Management Plan (SWMP) (2011) was developed for Westminster as part of Drain London which assessed flood risk and management/mitigation measures and developed a strategy and action plan.

5.4.2 Further enhanced surface water flood risk modelling was undertaken by WSP in 2015, the Westminster Initial Assessments study, followed by more recent modelling in 2023 which has informed this SFRA. Refer to Figure A-12 to Figure A-19.

5.4.3 The NPPF requires that site specific FRAs take account of all types of flooding including surface water flooding.

5.4.4 The complexity of development in Westminster and the difficulty in meeting housing requirements makes locating highly vulnerable and more vulnerable uses outside of areas of surface water flood risk difficult to achieve. However, all development must be safe from surface water flooding, and, unless there are practical reasons for not doing so, SuDS should be used to manage surface water runoff.

5.4.5 Appropriate SuDS for each scheme should take account of the local circumstances and should be incorporated into the surface water drainage strategy submitted as part of the FRA.

5.4.6 Pervious surfaces are encouraged as part of the surface water drainage strategy for all new developments in Westminster. Pervious surfaces provide a surface suitable for pedestrian and vehicular traffic, while allowing rainwater to infiltrate through the surface and into underlying layers and reduce surface water runoff. All new proposed driveways located within surface water management zones should incorporate pervious surfaces to manage surface water runoff. Although permitted development rights allow the improvement or extension of homes without the need to apply for planning permission (any paving of front gardens under $5m^2$), an Article 4 Direction should be considered to remove the permitted development rights for driveways within surface water management zones. Planning permission would then be required for all new proposed driveways located within surface water management zones where non-pervious materials are proposed.

5.4.7 The drainage strategy should also take account of the advice in the London Plan and the Mayor of London's supplementary planning guidance on Sustainable Design and Construction alongside policy 35J on sustainable drainage in the City Plan.

5.4.8 Developers proposing to submit a site-specific FRA and where necessary, surface water drainage strategy, will need to consider the following recommendations related to surface water flooding. The requirements for a surface water drainage strategy are provided in Appendix B and Appendix C; there are different requirements for Full, Outline, Reserved Matters and Discharge of Conditions applications.

5.4.9 The GLA London Sustainable Drainage Proforma is also required to accompany drainage strategies submitted with planning applications.

5.4.10 The Port of London Authority should also be consulted where there are any surface water outfalls proposed into the River Thames.

5.4.11 The London Sustainable Drainage Proforma developed by the GLA has been issued to all London LLFAs including Westminster. This proforma is required to accompany Sustainable Drainage strategies submitted with planning applications and will form part of planning application validation requirements. It sets a clear standard for the information that should be provided in a Sustainable Drainage strategy for all development in London.

SuDS

Surface Water SuDS Recommendation 1: In line with policy SI 13 of the London Plan and policy 35J of the City Plan, all new developments should utilise SuDS unless there are practical reasons for not doing so and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. This would reduce the overall amount of run-off produced and any associated flood risk while providing significant additional benefits not directly related to flood risk management.

Surface Water SuDS Recommendation 2: All new proposed driveways located within surface water flood risk management zone should incorporate pervious surfaces where possible to manage surface water runoff and will be required to have planning permission if non-pervious materials are proposed. An Article 4 Direction should be considered to remove the permitted development rights for driveways within surface water drainage management zones.

Highly Vulnerable and More Vulnerable uses

Surface Water Highly Vulnerable Use Recommendation: Any proposals for the re-development of Highly Vulnerable land uses such as self-contained basement dwellings, emergency command centres and power stations (sub-stations) should, if possible, be located/re-located outside of the area at surface water flood risk.

Surface Water More Vulnerable Use Recommendation: More Vulnerable land uses should also (where possible) be directed away from areas of high surface water flood risk.

Property Flood Resilience

Surface Water Property Flood Resilience Recommendation 1: All proposed developments within areas of surface water flood risk, should consider the use of PFR where appropriate depending on the level of risk and the nature of the proposals. Guidance on available options is available for example in the Mayor's Sustainable Design and Construction SPG.

Surface Water Property Flood Resilience Recommendation 2: Development proposed within the 1 in 100 year or within the 1 in 100 year (plus a 40% allowance for climate change) surface water flood extent, appropriate threshold levels to the development should be designed to minimise the risk of inundation from surface water flooding. These are recommended as 150mm above the maximum flood level. Refer to the City of Westminster updated surface water modelling (WSP, 2023) in Figure A-12 to Figure A-19 for flood depths and extents.

Evacuation Access and Egress

Surface Water Evacuation Access and Egress Recommendation 1: Residential basement dwellings within areas of surface water should have internal stair access to a safe haven within the building.

Surface Water Evacuation Access and Egress Recommendation 2: A FWEP should be implemented for 'highly' and 'more' vulnerable development within areas of surface water flood risk. In addition, existing more vulnerable land uses such as schools, care homes and hospitals located within areas of surface water flood risk should also consider implementation of an evacuation plan.

5.5 Basement Development in Westminster

5.5.1 Policy 45 of the City Plan provides guidance on basement development. This requires that all applications for basement development are accompanied by a structural methodology statement and appropriate self-certification from a suitably qualified engineer to demonstrate the impacts of the proposed development have been understood.

5.5.2 A site-specific FRA is also required for all self-contained basement developments and all other basement developments located within Flood Zone 2 and 3, or an area of surface water flooding (within a surface water management zone or within a surface water flow path in the 3.33% AEP event or above, identified in Figure A-12 to A-14). This should incorporate measures recommended in the structural statement to safeguard structural stability and address flood risk from all sources.

5.5.3 Cellars and basements can be vulnerable to flooding from several different sources, including the overflow of drains and nearby watercourses, groundwater flooding and surface water flooding. Although unlikely to change the groundwater regime, where basements are located close together their cumulative effect could alter groundwater levels.

5.5.4 Given their nature, basements are more susceptible to flooding, from surface water, groundwater and sewage, than conventional extensions. Fitting basements with a 'pumped device' (or equivalent reflecting technological advances) will ensure that they are protected from sewer flooding. Fitting only a 'non-return valve' is not acceptable as this is not effective in directing the flow of sewage away from the building.

5.5.5 It is important to establish whether there is a significant flood risk before it is decided to go ahead with an application for basement excavation or conversion. In particular, potential applicants should first determine whether the application property is located in a flood risk zone or within an area of surface water flood risk.

Basement Development Recommendation 1: All basements at risk of flooding from surface water or reservoir failure must have access situated 300mm above the design flood level to be utilised in an emergency. Evidence must be provided to support this assessment.

Basement Development Recommendation 2: Self-contained basement dwellings should be located outside of areas of surface water flood risk or at risk of flooding from reservoir failure. If building a basement extension in any area prone to surface water flooding steps should be taken to avoid increasing (and reducing) surface water flood risk for the site. A number of sustainable drainage measures can be used to reduce the surface water run-off from a site including rainwater tanks, pervious surfaces and living roofs. Retrofitting of Sustainable Drainage Systems will be encouraged. Applicants should also show they have had regard to the drainage hierarchy in the London Plan and justification provided where this is not practical or appropriate.

Basement Development Recommendation 3: Basements may be more susceptible to sewer flooding; as a minimum all drainage connections from basements to sewers should be fitted with a one-way valve to prevent drains flooding the basement if they surcharge. During periods where drains are surcharged, the drainage system may not work. Basement designers should consider installing pumped sewerage system to protect against this, particularly in areas where there is an increased sewer flood risk.

Basement Development Recommendation 4: Basement development may impact groundwater flooding where the basement floor level extends into or close to existing groundwater. A site-specific FRA should assess where:

- Basements extend through the gravels below the perched water table into the underlying London Clay or which have their lower levels close to the level of Upper Aquifer (within 300mm of it);
- Basements are in the vicinity of the historic routes of the Westbourne and Tyburn Rivers and their tributaries (Figure 1); and,
- New basements proposed to existing houses with basements or lower ground floors, where the existing perched water level is close to the lowest occupied area of existing buildings.

Basement Development Recommendation 5: As part of basement design, a geotechnical assessment should be carried out to ensure that that there are no groundwater related issues as in Recommendation 4, and that the basement is not displacing groundwater around it. Although it is noted that it is often a combination of the above types of flooding that leads to increased flood risk, the engineering design should take account of the specific combinations of geo-hydrological conditions on the site. This should be considered in a structural statement and geotechnical report.

Basement Development Recommendation 6: In all basement development, applicants should incorporate flood resistance and resilience measures as part of the design. This includes measures to prevent water ingress and to reduce flood damage should flooding occur. These may include placement of electrical circuits to minimise potential for damage, flood resistance doors, automatic closing air vents or demountable flood barriers/gates.

6 Addressing Flood Risk in Westminster

6.1 Strategic Approach

6.1.1 Westminster City Council are developing a strategic approach to managing flood risk throughout the borough, in accordance with the policies in the London Plan, City Plan and the recommendations arising from the July 2021 flood events.

6.1.2 Westminster City Council are currently reviewing their gully maintenance strategy, to determine if the current frequency and strategy of maintenance is still appropriate or could be further optimised. An investigation into the existing gully maintenance procedures has begun, with initial reviews indicating that the gully network was working effectively during the 12th July flood event. The average silt levels within gully pots were within the council's optimum range of 60% to 70% in the streets affected by flooding, and after subsequently checking the average silt levels across the whole borough it was confirmed that the 60%-70% average silt level targets were being met boroughwide.

6.1.3 Opportunities for a more strategic retrofitting of SuDS within Westminster are currently being investigated, building on the results of the London Strategic SuDS Pilot Study. The goal is to promote a more widespread introduction of SuDS within Westminster City Council public realm, which will improve long term resilience reducing surface water flood risk and maximising the benefits associated to green infrastructure, in accordance with Policy 35 of the City Plan. This is also linked to Westminster City Council's objective within the Thames Flood Risk Management Plan (FRMP) (2021 to 2027)[9]:

- By 2024, Westminster will create a strategy targeting sustainable urban drainage systems development in the borough to link into the wider Westminster Green Infrastructure Strategy in the Greater London, Thames Flood Risk Area.

6.1.4 Westminster City Council is currently developing further guidance and procedures for planning applications, with regards to flood risk management. This will be linked to the guidance provided in Appendix B and Appendix C, supporting developers to provide FRAs and drainage strategies which adequately consider flood risk from all sources and include appropriate mitigation measures such as SuDS. This is linked to Westminster City Council's objective within the FRMP:

- By 2024, Westminster will work with internal planning around strategic development areas in the borough to incorporate sustainable urban drainage systems into master planning in the Greater London, Thames Flood Risk Area.

6.1.5 In line with the updated procedures for planning, developers will also be required to demonstrate that drainage has been constructed according to approved plans through post-construction verification reports, these will also include a GIS shapefile for the development site and any details related to SuDS and green infrastructure.

6.1.6 An updated Local Flood Risk Management Strategy (LFRMS) is currently being developed, in order to take account of the current approach to flood risk management policies and reflect the aspirations and priorities of Westminster City Council and other partners with flood risk management responsibilities. The Strategy will also consider wider local interests linked with environmental or social outcomes, creating an action plan to meet objectives for flood risk management and local needs. The action plan will continue to be monitored and reviewed in order to ensure it is fully implemented and measure the successes. This is linked to Westminster City Council's objective within the FRMP:

[9] https://www.gov.uk/government/collections/flood-risk-management-plans-2021-to-2027

- By 2024, Westminster will explore innovative ways to engage with workers, residents, visitors and learners to communicate flood risk and resilience in the borough to help them understand the risks they might face thus reducing the consequences of flooding for human health in the Greater London, Thames Flood Risk Area.

6.1.7 Westminster City Council will develop a Riverside Strategy to support the TE2100 plan in providing long term protection from flooding from the River Thames. The aim of the Riverside Strategy will be to identify how Westminster City Council will deliver the local flood defences required, taking account of sea level rise. As well as considering flood protection through raising and maintenance of defences, the Riverside Strategy will also consider how to maintain access to the River Thames, improvements to pedestrian access along the riverside, protection of historic and heritage sites, safeguarding health and wellbeing along the riverside, biodiversity net gain and amenity value.

6.1.8 Westminster City Council is currently developing a Green Infrastructure Strategy, which will review the extent to which green infrastructure assets are functioning well, to identify where there are existing and anticipated future gaps in green infrastructure provision and set out what actions could enhance the current provision. As part of this Green Infrastructure Strategy, the implementation of SuDS throughout Westminster will be considered and promoted. This will also contribute to the Infrastructure Delivery Plan, produced as part of the City Plan.

6.2 Sustainable Drainage Systems (SuDS)

6.2.1 SuDS are designed to drain water in a more sustainable way than conventional techniques, by mimicking natural drainage. They can achieve a number of objectives including controlling surface water runoff from developments, removing pollutants from urban run-off at source, and combining water management with green infrastructure, which can improve landscape, amenity and biodiversity. Given the climate change predictions for increased frequency and intensity of rainfall events, the use of SuDS is becoming increasingly important in improving resilience and will help deliver Water Environment (Water Framework Directive) (England and Wales) Regulations objectives for improving water quality. Some SuDS components provide water quality improvements by reducing sediment and contaminants from runoff either through settlement or biological breakdown of pollutants. This can improve the quality of downstream water bodies. Furthermore, where SuDS reduce flows entering combined sewers, this can lead to reduced combined sewer overflow discharges (controlled discharge of surface water runoff and sewage), again improving the quality of the receiving water body.

6.2.2 Westminster City Council's approach to the use of SuDS is detailed in the City Plan (Policy 35J). The policy states that all development proposals must incorporate SuDS to alleviate and manage surface water flood risk. Policy 34B on Green Infrastructure asks that developments contribute to the greening of Westminster by incorporating trees, green walls, green roofs, rain gardens and other green features and spaces wherever possible.

6.2.3 London Plan Policy SI 13J promotes the use of SuDS and recommends the management and re-use of surface water before it is discharged.

6.2.4 As discussed in Section 5, the GLA has developed the London Sustainable Drainage Proforma for LLFAs including Westminster. This proforma is required to accompany Sustainable Drainage strategies submitted with planning applications and will form part of planning application validation requirements. It sets a clear standard for the information that should be provided in a Sustainable Drainage strategy for all development in London.

6.2.5 The following recommendations with regards to SuDS are used to guide drainage strategies supporting planning applications for development in Westminster, in accordance with the checklists provided in Appendix C:

- Consideration be given to rainwater harvesting and recycling, pervious surfaces, green/blue roofs and other appropriate SuDS measures to reduce runoff rates to the conventional drainage system.
- Wherever practicable, developers should aim for a greenfield runoff rate from their development; where this is not possible developers should demonstrate how all opportunities to minimise site runoff have been taken to get it as close to greenfield standard as possible.
- Regular management and maintenance checks must be carried out on any SuDS features to ensure that the system always remains fully operational. Issues of adoption and future maintenance should be fully explored before implementation.
- Developments should seek to reduce the amount of impermeable areas where possible.
- Developers should aim to incorporate pervious surfaces in hardstanding areas to provide flood mitigation in both new and existing developments. In areas where infiltration is not feasible, pervious surfaces should be underlain with underground storage systems.

7 Contingency Planning

7.1.1 Contingency plans are designed to put mechanisms in place to coordinate the council's response to a major incident such as flooding. Business continuity plans ensure that core critical services are maintained in the event of major disruption.

7.1.2 Westminster City Council has developed the City of Westminster Contingency Plan for Major Emergencies[10], which sets out the procedures applied to emergency management (including flooding) including the command, control and coordination structures to coordinate the council's response to a major incident. This includes what actions the council will take and how, including the command, control and communications structures that are to be used, the roles and responsibilities of council services, and how the council will work with others to respond to a major emergency.

7.1.3 Supporting this is the London Resilience Partnership - Strategic Flood Response Framework[11]. The objectives of the Strategic Flood Response Framework are to:

- Identify triggers and mechanisms for invoking a London-wide strategic response;
- Provide responders with some context around the impacts of each type of flood risk;
- Confirm the actions responders should take at each stage of a flooding incident; and,
- Provide the necessary links to existing plans and procedures.

7.1.4 Westminster City Council's Emergency Planning Team updated and published the Westminster Multi Agency Flood Plan in January 2023 which is maintained and updated by the Major Incidents and Contingency Planning Team and is reviewed on an annual basis. It was developed in partnership with the Borough Resilience Forum.

7.1.5 For further information on any of the matters above, the Major Incidents and Contingency Planning team can be contacted at contingencyplanningteam@westminster.gov.uk.

[10] Westminster City Council (2007) City of Westminster Contingency Plan for Major Emergencies. Available from: http://www3.westminster.gov.uk/docstores/publications_store/Public%20Continuity%20Plan.pdf [Accessed 20 December 2022]

[11] London Resilience Partnership (2020) Strategic Flood Response Framework. Available from: https://www.london.gov.uk/sites/default/files/london_strategic_flood_response_framework_2020_v3.2.pdf [Accessed 20 December 2022]

8 Review and Next Steps

8.1 Review

8.1.1 This SFRA has been developed in accordance with the most recent legislation, policy and flood risk information available at the time of writing. This SFRA is intended to be used to assist with development and planning within the Westminster City Council area, considering existing and future flood risk from all sources.

8.1.2 For this SFRA to continue to be used as a practical planning tool now and in the future, it must be adopted as a 'living document' to be reviewed periodically in light of emerging policy and more up to date information regarding flood risk.

8.1.3 The following events may trigger a review and update of the SFRA:

- Changes to the NPPF and associated Flood Risk and Coastal Change PPG which form the basis of the SFRA;
- Updates to any of the overarching legislation which may alter the responsibilities of Westminster City Council;
- Significant updates to available flood risk information used to develop the SFRA;
- Improved understanding of local flood risk knowledge; and,
- Following a major flooding event within the Westminster City Council area.

8.2 Next Steps

8.2.1 This SFRA will support Westminster City Council in assessing the impact of climate change with regards to increasing flood risk now and in the future. The policies and guidance provided aim to support developers to reduce flood risk associated with developments, through mitigation measures such as SuDS. The process of implementing these mitigation measures through new developments will ensure Westminster City Council is able to adapt to climate change.

8.2.2 In order to capture how well Westminster City Council is adapting to climate change, all future planning applications will be assessed against the requirements set out in this SFRA. This data will be collected from the time of publication so that the next iteration of the SFRA can review how well new developments have adapted to climate change. This will also include an assessment of what recommendations from the SFRA have been taken forward to future iterations of the City Plan, and what recommendations still need to be implemented.

Appendix A: Mapping

Appendix B: FRA and Drainage Strategy Requirements for Planning Applications

Appendix C: FRA and Drainage Strategy Checklists for Planning Applications