PRICE& MYERS

Land adjacent to No. 46 Maresfield Gardens Camden, London

Flood Risk Assessment and Drainage Strategy Report

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Acronyms	
AOD	Above Ordnance Datum
CIRIA	Construction Industry Research and Information Association
CDA	Critical Drainage Area
DCG	Design and Construction Guidance
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
FRA	Flood Risk Assessment
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water Management Plan
LBC	London Borough of Camden

1 Introduction

Price & Myers have been commissioned to undertake a Flood Risk Assessment (FRA) and Drainage Strategy Report for the proposed development on the land adjacent to 46 Maresfield Gardens, located in the London Borough of Camden.

The National Planning Policy Framework (NPPF) states that an appropriate FRA will be required for all development proposals of 1 ha or greater in Flood Zone 1 and for any development within Flood Zones 2 or 3.

The EA's indicative floodplain map shows that the site is in Flood Zone 1, however, as shown in Figure 1.1, the London Borough of Camden has identified the area as a Critical Drainage Area (CDA) in its SFRA, (see Appendix A) and an FRA is required to accompany the planning application. This FRA will assess all types of flood risk including watercourses, overland flows, groundwater, sewers and artificial sources.

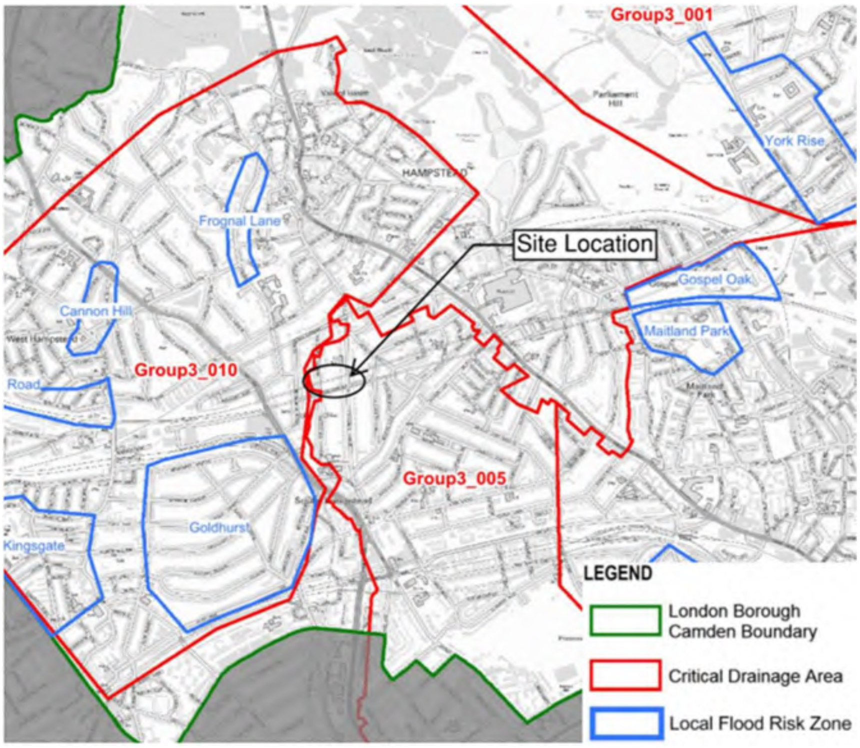

Figure 1.1: The London Borough of Camden SFRA Critical Drainage Areas

This report will also outline the proposed drainage strategy for the site including a detailed SuDS assessment.

1.1 Relevant Policy

This FRA has been carried out in accordance with the NPPF and the accompanying Planning Practice Guidance (PPG) "Flood Risk and Coastal Change". This FRA also incorporates advice and guidance from the Environment Agency (EA), the London Borough of Camden Strategic Flood Risk Assessment (SFRA) (January, 2024) and CIRIA documents.

The surface water drainage strategy is in accordance with:

- The Department for Environment, Food and Rural Affairs (DEFRA) "Non-Statutory Technical Standards for Sustainable Drainage Systems". (March, 2015)
- Building Regulations Part H (December, 2010)
- London Borough of Camden Level 1 Strategic Flood Risk Assessment (SFRA) (January, 2024)
- The London Plan (March, 2021)
- The Department for Environment, Food and Rural Affairs (DEFRA) "Climate Change Allowances" (2019)

2 Site Description and Location

The site is located at the junction of Maresfield Gardens and Nutley Terrace, in the Hampstead area of Camden with approximate OS coordinates of 526476, 184984, grid reference TQ264849 and the site postcode is NW3 5RX. Most of the site is occupied by soft landscaping, with larger trees to the north of the site having significant root protection zones, while smaller trees with smaller root protection zones are located to the west and south. At the centre of the site there is a 3.7m diameter brick airshaft structure associated with the Network Rail railway tunnel below the site.

The site can be accessed via a gate along Maresfield Gardens, located to the north of the site boundary. A topographical survey has been carried out by EDI Surveys (March, 2015) and shows the site is relatively flat with the existing external ground level sloping slightly up from 73.760 AOD to the South West of the site to 74.456 AOD to the North East of the site, refer to Appendix B for survey. The site is bounded by a brick wall, separating the site from the public footpaths along Maresfield Gardens and Nutley Terrace.

The site area is approximately 0.26ha.

Figure 2.1: Existing site, showing site boundary (Google Maps)

2.1 Existing Drainage

The Thames Water (TW) Asset Map, contained in Appendix C, shows that there are combined public sewers located in both Nutley Terrace to the south and Maresfield Gardens to the west of the site. The combined sewer to the west of the site is 965x610mm while to the south of the site the sewer has a diameter of 305mm. There are no public sewers shown to be located within the site boundary.

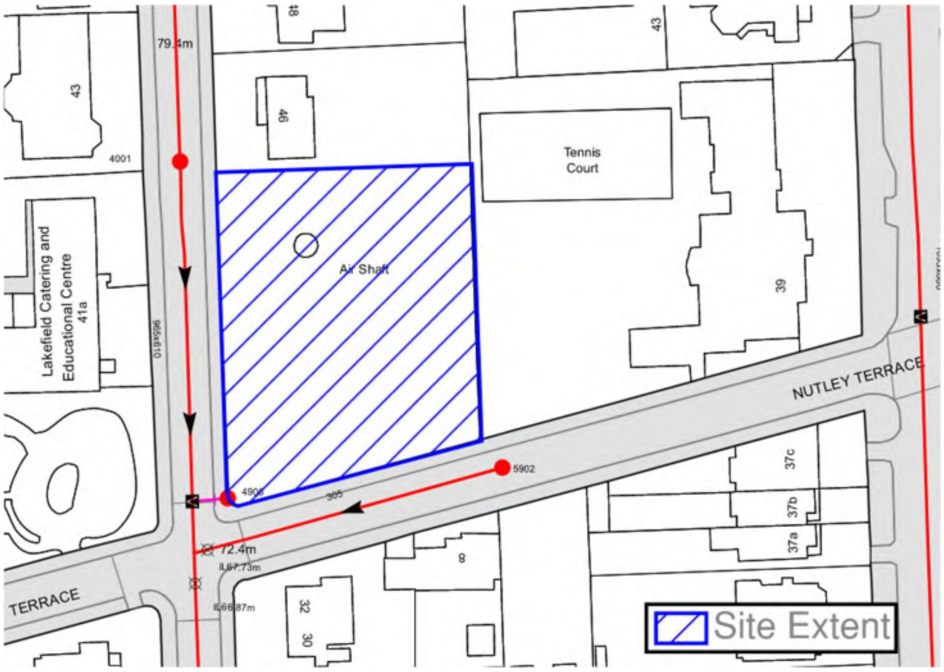

Figure 2.2: Existing drainage (Source: Thames Water Asset Search, 2022).

A CCTV survey has not been undertaken due to there being no manholes indicated on the site topographical plan in Appendix B. It is therefore assumed that there are no existing private drainage networks within the site boundary and surface water within the site infiltrates naturally to the ground.

A CCTV survey was carried out on the neighbouring site, 39 Fitzjohn’s Avenue, and identified a private combined drainage network serving the existing buildings, discharging to a Thames Water public sewer to the east of the site in Fitzjohn’s Avenue. However, it identified no connections from the proposed Maresfield Gardens site.

3 Development Proposal

The proposed development consists of a new four-story residential building, with two additional basement levels, providing a total of 29 units ranging from 1 to 3 bed flats and an approximate footprint of $870m^2$. The proposed building includes balconies, fitness areas and cycle storage space, while maintaining several existing mature trees surrounding the site.

Figure 3.1: Proposed layout of Maresfield Gardens (Source: Sergison Bates Architects)

Figure 3.2: Proposed site landscaping layout (Source: Bowles & Wyer Landscape Architects)

4 Flood Risk Assessment

4.1 Flood Risk from Watercourses

The EA's flood map for planning shows that the site is located in Flood Zone 1 and is not at risk of flooding. Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere.

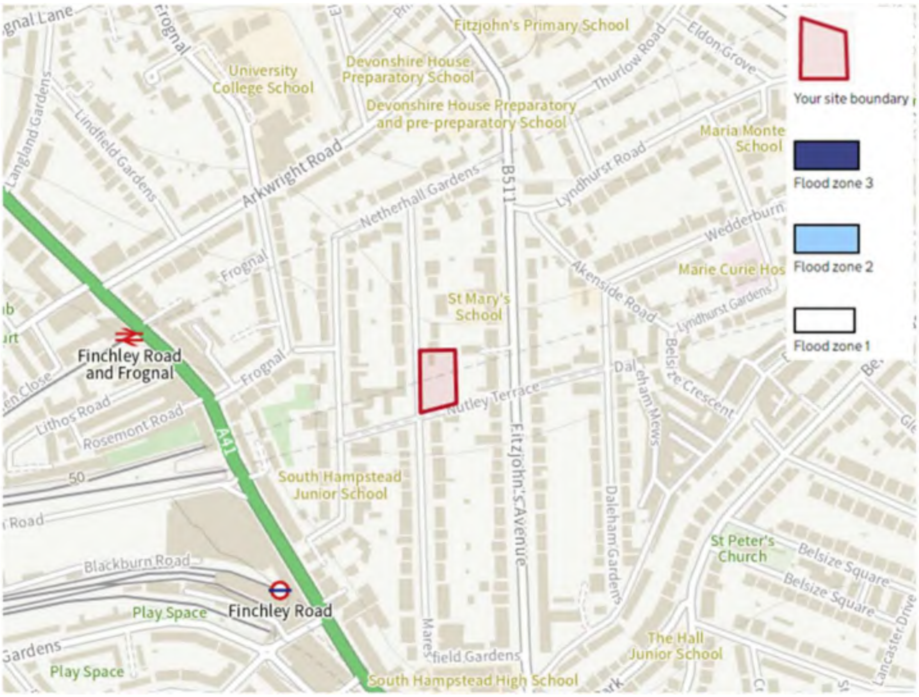

Figure 4.1: from EA Flood Map for Planning

No mitigation measures have been proposed for watercourse flooding, as the site is located in Flood Zone 1 and is therefore at low risk of watercourse flooding.

4.2 Flood Risk from Groundwater

Groundwater flooding occurs when water originating from sub-surface permeable strata emerges from the ground, typically after prolonged rainfall.

A ground investigation report was undertaken by GEA Consulting (December, 2023, REF: J23181) and included field observations, in-situ testing and geotechnical laboratory analysis. The report concluded that the ground conditions consisted of made ground to depths of between 0.3m to 1.3m and *"comprised of a matrix of dark brown, greyish brown silty sandy gravelly clay and gravelly sand".* Boreholes 2 and 3 identified gravel clay deposits to a depth of 2m, whereas elsewhere London clay was also encountered to the full depth of the investigation at 15.00m.

Groundwater was only encountered in borehole 6 at a level of 72.580m within the London Clay, therefore it is likely that is perched groundwater and not a representative groundwater level.

The site investigation also undertook a groundwater monitoring assessment in the boreholes, *"three weeks after the drilling of the boreholes recorded the installed standpipes to be dry"*. The report also states that the London Clay *"cannot support groundwater flow (or) a water table"*. Therefore, it is assumed based on the findings of the ground investigation report, that as the site is underlain by the London Clay formation, there is a low risk of groundwater flooding.

The report also states that *"significant groundwater inflows are not generally expected to be encountered in the basement excavation… minor localised groundwater inflows may therefore be encountered, in addition to perched groundwater from overlying made ground… any such inflows or seepages should be adequately delt with through sum pumping".* Therefore, assuming a suitable and efficient cavity drainage system is installed for the basement level, the risk of groundwater flooding is low.

Figure 4.2 taken from The London Borough of Camden SFRA indicates that the site does not have an increaesd suceptability to groundwater flooding with no historic ground water flooding incidents recorded by either the EA or the LBC.

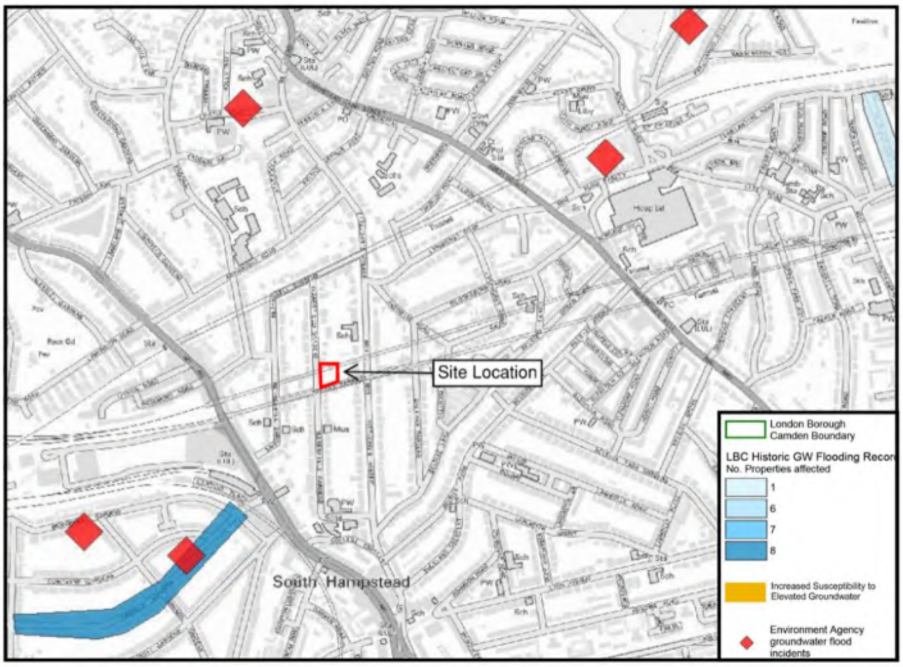

Figure 4.2 Camden SFRA Increased Susceptibility to Elevated Groundwater map.

4.3 Flood Risk from Surface Water and Overland Flows

Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter a drainage system due to blockages or the capacity of the system being exceeded. Overland flows can also be generated by burst water mains, failed dams and any failure in a system storing or transferring water.

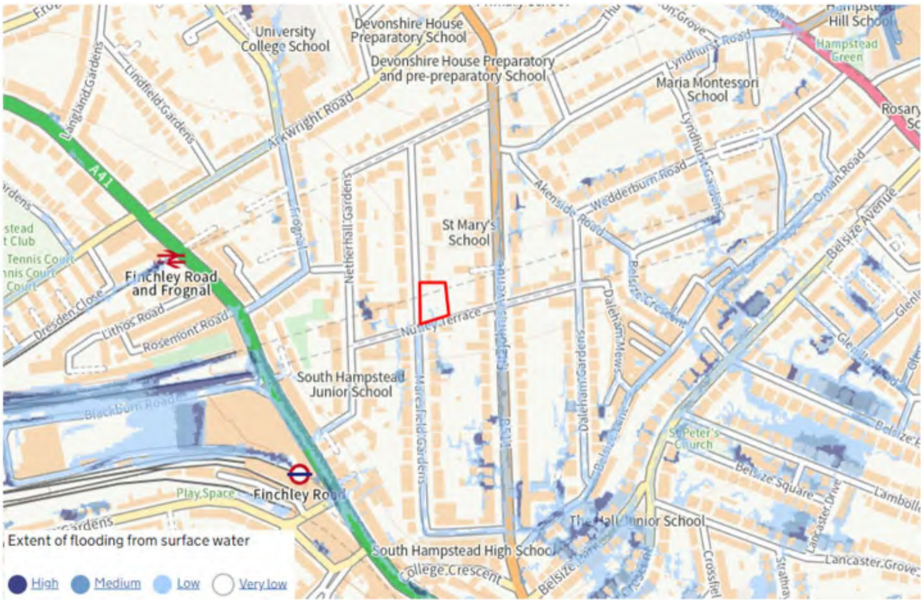

Figure 4.3 Environment Agency Surface Water Flood Risk Map

The EA's indicative Surface Water Flooding Map, Figure 4.3, shows that the site is at very low risk of surface water flooding. As the site has been identified as a CDA within the Camden SFRA, see Figure 1.1, it is therefore proposed to attenuate the surface water run-off from the site in below ground storage tanks, these will discharge to the Thames Water network located in Nutley Terrace to the south of the site.

Section 7.1 of this report assesses the existing surface water exceedance flows across the site. Given the site levels currently fall to the south west, this is the direction of the existing exceedance flow paths.

As discussed in Section 5.2, the discharge from the site will reduce the peak run-off to a rate of 3.2l/s. This is considered the lowest achievable rate without increasing flood risk, no additional mitigation measures have been proposed and the surface water flood risk is low.

4.4 Flood Risk from Reservoirs

The EA provides information on flood risk from reservoirs. The map showing the maximum extent of flooding from reservoirs was updated in 2021 and now shows the combined effects of flooding from reservoirs and rivers. Figure 4.4 shows that the site is not at risk of reservoir flooding when river levels are normal.

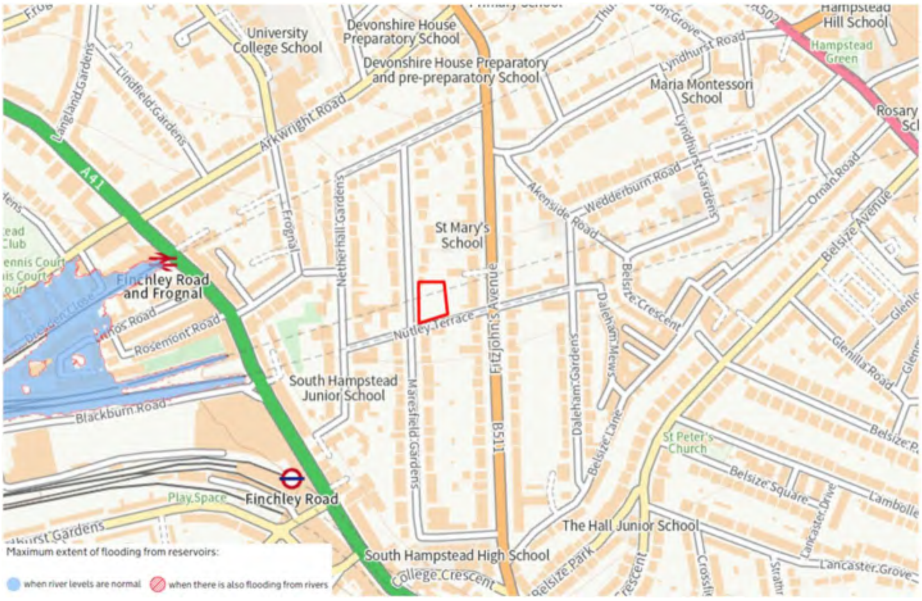

Figure 4.4 Environment Agency Risk of Reservoir Flooding Map

The EA's information states that reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Reservoir Act of 1975 ensures that reservoirs are inspected regularly, and essential safety work is carried out. Therefore, the site is at very low risk of reservoir flooding and no mitigation measures have been proposed.

4.5 Flood Risk from Sewers

The London Borough of Camden has provided information on internal and external sewer flood risk in this area, see Figure 4.5 below.

Sewer flooding occurs when the flow entering the sewerage network is greater than the capacity of the sewers. The London Borough of Camden SFRA has provided information on incidents of sewer flooding by postcode area.

The site is located within the NW3 5 postcode area and according to the SFRA, this area has experienced 6-20 incidents of sewer flooding, the report provides no further details on where the sewer flooding occurred, but it is reasonable to assume that there is low risk of sewer flooding within the NW3 5 postcode area.

As outlined in Section 2.1, there are combined public sewers located in both Maresfield Gardens and Nutley Terrace, to the west and south of the site respectively. The site levels, as discussed in Section 2, currently fall towards the southwest corner of the site, at the junction between Maresfield Gardens and Nutley Terrace, this corresponds with the fall of the public sewers. Therefore, if the sewers were to surcharge then the flood levels would follow the highway levels, falling away from the site towards the junction between Maresfield Gardens and Nutley Terrace, and any sewer flooding would be unlikely to affect the site.

Further sewer flooding protection has been provided by pumping the lower ground level surface and foul water, to a combined manhole before discharging via a gravity connection into the Thames

Water public network. Pumping the lower ground floor drainage will prevent this area flooding, if the drainage elsewhere on the site, or the public network become surcharged. In the event of a mechanical issues with the pump system, the pumps will be designed to provide a minimum of 24hours storage.

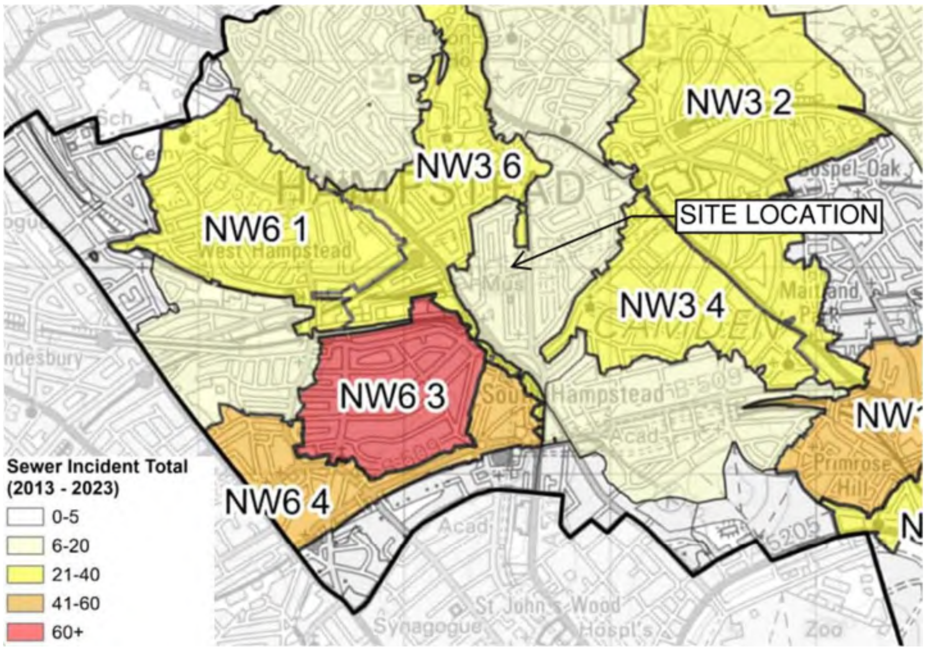

Figure 4.5 The London Borough of Camden SFRA External Sewer Flooding Map

As the area has a relatively low risk of sewer flooding compared with other areas in Camden, no further mitigation measures have been proposed against sewer flooding.

A predevelopment enquiry has been submitted and approved by Thames Water and this confirms that there is sufficient capacity available within their public drainage network to handle the foul and surface water flows from the proposed development without increasing the risk of sewer flooding.

4.6 Summary of Flood Mitigation Measures

Flood Risk from:	Summary and Mitigation Measures
Watercourses and Tidal Flooding	EA Flood Risk map for Planning shows the site is located within Flood Zone 1, therefore the site is at low risk of flooding from watercourses and no mitigation measures have been proposed.
Groundwater Flooding	The site is at an overall low risk of groundwater flooding and no further mitigation measures have been proposed. The GEA ground investigation report recommends that the basement should have a cavity drainage system to protect against any GW flows.
Surface Water and Overland Flows	The EA's indicative Surface Water Flooding Map shows the site is at 'Very Low' risk of surface water flooding. The development proposes attenuating surface water run off from the site in below ground storage tanks, before discharging to the Thames Water network reducing the peak run-off rate to 3.2l/s.
Reservoir Flooding	The EA's information states that reservoir flooding is extremely unlikely to happen. The EA's map shows that the site is at low risk of reservoir flooding and no mitigation measures are proposed.
Sewers	The Camden External Sewer Flooding Incident Map indicates there is a low risk of flooding for the site postcode area. Site levels have been designed to fall away from building thresholds, a pumped system for the lower ground floor level will further help prevent flooding of this lower level caused by surcharging. No further mitigation measures have been proposed.

Table 4.1 Summary of Flood Mitigation Measures

5 Surface Water Run-off Assessment

5.1 Existing Run-off

The total site area is approximately 2634m^2 or 0.263 ha, it is assumed that the entire site is currently permeable and infiltrating to the ground, as described in Section 2.1.

The existing site run-off rate for the design storm events was calculated using the FEH Green Field Run off rate estimation method. For storm events of several different return periods were calculated using the FEH method and are summarised below. Supporting documentation is contained in Appendix D.

Q_{BAR} = 1.26 l/s
$Q1_{Gr}$ = 1.07 l/s
$Q30_{Gr}$ = 2.90 l/s
$Q100_{Gr}$ = 4.02 l/s

5.2 Proposed Impermeable Area and Discharge Rates

5.2.1 Proposed Discharge Rates

The London Plan states that developments should aim to achieve Green Field runoff rates. The discharge rate for the proposed development shall be restricted to as near to the greenfield run-off rates outlined as reasonably practicable.

The Green Field run-off rates presented in Section 5.1, are so low that attenuated flow rates are difficult to achieve in reality, without increasing flood risk due to the small diameter orifices required to reduce run-off to these rates and the increased risk of blockage caused by small orifice openings, the minimum requirement of orifice openings is set out in Part H of Building Regulation requirements.

The proposed surface water design will therefore propose reducing the peak run-off to 3.2l/s, this is considered the lowest achievable rate without increasing flood risk and maintains the minimum 75mm orifice diameter required by Part H of Building Regulations. This will be the peak run-off rate for all storms including the extreme 1 in 100 year + climate change event and will be achieved by the use of a Hydrobrake flow control device (Unit Ref: MD-SHE-0075-3200-1800-3200), this will restrict the discharge downstream of the proposed below ground storage tank , prior to out falling to the TW public sewer network. FCMH on drawing 30846-600 in Appendix E.

5.2.2 Climate Change

The current EA guidance on climate change allowance states that new drainage systems must be designed to ensure that there is no increase in the rate of runoff discharged from the site for the “Upper End” allowance. The expected lifetime of this development is 100 years, therefore a 40% allowance must be used in the design. This provides a betterment of the 30% climate change allowance consideration, as suggested by LBC SFRA.

5.3 Surface Water SUDS Strategy

The London Plan states that developments should ensure that surface water runoff is managed as close to its source as possible utilising sustainable methods (SUDS). There should be a preference for green over grey infrastructure in line with the following drainage hierarchy outlined in Policy SI 13 of the London Plan:

Rainwater Used as a Resource (e.g., Rainwater Harvesting)

Rainwater harvesting promotes the storage and re-use of rainwater collected from roofs and hard surfaced areas. This type of system contributes to the reduction of runoff rates and volumes within a development.

The capacity of rainwater harvesting systems to attenuate rainwater depends on the water use within the building. If there is no activity in the building or other water use and the harvester is full, no attenuation will be provided during a subsequent storm event. In the worst-case scenario, the rainwater harvester will provide no attenuation.

Rainwater harvesting has been considered for this site and options are being evaluated, the landscape architect is currently assessing the suitability of a rainwater harvesting system for use as part of an external irrigation system The private rainwater harvesting butts are also being provided for the individual units. If the site is found to be suitable, these systems may be used for irrigation.

Rainwater Infiltration

As discussed in Section 4.2, the ground investigation report concluded that the site ground conditions consisted of made ground to a depth of between 0.3m to 1.3m above the London Clay formation, to the full investigation depth of 15.00m.

The ground investigation report states that *"only a small percentage of the site is currently developed or covered in hardstanding, therefore a significant portion of rainwater will infiltrate the ground beneath the site"*, the report also noted that there is *"good potential"* for surface water infiltration at ground level, therefore it is proposed that areas of soft landscaping including external paths are able to infiltrate to the ground.

The site is underlain by the London Clay Formation with a *"low permeability",* the report did not include any onsite infiltration testing, however published infiltration rates for London Clay suggest a rate in the range of $1x10^{-9}$ to $1x10^{-11}$m/s, such low rates would be unfeasible to support an infiltrating system for the surface water from the site. It is therefore assumed that the surface water run-off cannot be effectively disposed of to the ground via infiltration and is not a feasible means of disposing of surface water.

In accordance with Building Regulations Part H, *"infiltration devices should not be built within 5m of a building or road"*, given the RPAs of the existing trees, the basement foundations and the adjacent roads on the west and southern boundaries, a soakaway system is not a feasible design.

5.4 Rainwater Attenuation

Due to the infeasibility of infiltration, it is proposed to attenuate surface water in below ground attenuation tanks, this will provide sufficient storage to reduce the surface water discharge to a rate of 3.2l/s to the combined sewer. The tank has been located to the south of the site along Nutley Terrace, the location has been chosen to suit the existing site levels and avoid the constraints of the existing tree RPAs. See drawing 30846-600 in Appendix G

In accordance with the recommendations of the ground investigation report as discussed above, permeable paving has been proposed for all areas of external hard landscaping given the site is largely covered in existing trees which are set to be retained. Any build up over tree RPAs will include a Cellweb layer to avoid damage to the roots.

Green roofs and a small pond have been proposed for the development, this will provide some additional capacity for surface water attenuation and inception at source, contributing towards reducing the water flow into the surface water network and increase biodiversity and water quality benefits.

As discussed in Section 5.1 the proposed surface water peak run-off rate will be restricted to 3.2l/s. This will be the peak run-off rate for all storms including the extreme 1 in 100 year + 40% climate change event and will be achieved using a Hydrobrake flow control device downstream of the attenuation (Unit Ref: MD-SHE-0069-3200-2500-3200).

The proposed drainage strategy drawings are included in Appendix E and the hydraulic calculations are available within Appendix F.

Controlled Rainwater Discharge to a Combined Sewer

As outlined in Section 2.1, the Thames Water (TW) Asset Map, Appendix C, shows that there are no surface water sewers located near to the site. The combined sewer to the west of the site is 965x610mm in diameter while to the south of the site the sewer is 305mm diameter. There are no public sewer connections shown to be located within the site boundary.

It is therefore proposed to construct a new connection to the 305mm diameter combined sewer, reducing disruption to the existing tree RPAs located along the site boundary. Thames Water have confirmed their network has sufficient capacity for a 3.2l/s gravity surface water connection, see Appendix H, the connection is also subject to a Thames Water Section 106 agreement.

6 Surface Water Maintenance Strategy

The successful implementation and operation of a SuDS system depends on a robust and clear maintenance strategy being implemented. The following measures should form part of the site's proposed management plan.

It is envisaged that the majority of the site drainage and the SuDS will be maintained by the private management company of the proposed development and will form part of the overall maintenance regime for the site.

SuDS Element	Maintenance Activity	Required Action	Typical Frequency
Green Roofs	**Monitoring / Inspections**	Inspect all components including soil substrate, vegetation, drains, irrigation systems, membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
		Inspect soil substrate for evidence of erosion channels and identify any sediment sources	
		Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	
		Inspect underside of roof for evidence of leakage	
	Regular Maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Half yearly and annually or as required
		During establishment i.e. year one, replace dead plants as required	Monthly -but usually responsibility of manufacturer
		Post establishment, replace dead plants where > 5% of coverage	Annually in autumn
		Remove fallen leaves and debris from deciduous plant foliage	Half yearly or as required
		Remove nuisance and invasive vegetation, including weeds	
		Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	
	Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required

SuDS Element	Maintenance Activity	Required Action	Typical Frequency
		If drain inlet has settled, cracked or moved, investigate and repair as appropriate	
Permeable Paving	Monitoring / Inspections	Initial inspection	Monthly for three months after installation
		Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 hours after large storms in first six months
		Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
		Monitor inspection chambers	Annually
	Regular Maintenance	Brushing and vacuuming -standard cosmetic sweep over whole surface	Once a year after autumn leaf fall
		Rubbish and litter removal	As required
	Remedial Actions	Remediate any landscaping which through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required
		Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	
		Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required
Attenuation Tank	Monitoring / Inspections	Inspect all inlets, outlets, vents, overflows and control structures to ensure they are working as they should	Annually or after severe storms
		Inspect and identify any elements that are not operating correctly.	Monthly for three months, then half yearly or as required.
	Regular Maintenance	Remove sediments / debris from catch pits / gullies and control structures	Annually, after severe storms or as required
	Remedial Actions	Repair inlets, outlets, vents, overflows and control structures.	As required

Table 6.1 SuDS Maintenance Strategy as taken from The SuDS Manual

Effective SuDS design must assess all foreseeable risks during construction and maintenance. These must be mitigated during the detailed design stages where effective design will aim to avoid, reduce and mitigate risks. This process will also require input from the principal contractor who will ensure the construction of SuDS components are carried out in a safe and sustainable manner.

7 Exceedance Routes and Overland Flows

Surface water exceedance and overland flows occur when intense rainfall is unable to either soak into the ground or enter a drainage system; due to blockages or the capacity of the system being exceeded. Although drainage systems are currently designed for extreme storm events, it is not economical or sustainable to build large, oversized drainage networks for all types of extreme rainfall or scenarios. As a result, there will be occasions when surface water runoff will exceed the capacity of drains as outlined in CIRA 635 document 'Designing for exceedance in urban drainage – good practice"':

> "It is inevitable that as a result of extreme rainfall the capacities of sewers, covered watercourses and other drainage systems will be exceeded on occasion. Periods of exceedance occur when the rate of surface runoff exceeds the drainage system inlet capacity, when the pipe system becomes overloaded, or when the outfall becomes restricted due to flood levels in the receiving water."

Designing for exceedance aims to divert and control flood flows along routes where the risk of property flooding and the risk to health and safety is minimised and can be managed.

The following sections assess the overland flow routes for the existing and developed site. Proposed mitigation measures, where required, are then developed which will be incorporated into development proposals. These will route water away from vulnerable areas, avoid creating hazards to end users and also not increase flood risk on or off site.

7.1 Existing Exceedance and Overland Flow Routes

As discussed in Section 2, the site levels fall around 1m from the northeast to the southwest of the site. This correlates with the possible surface water exceedance flow paths across the site, as shown in Figure 7.1 below and Appendix G.