MHA STRUCTURAL DESIGN

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81 Belsize Park Gardens, Flood Risk Assessment and Drainage Strategy

Aug 2023

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P1	Issued.	2023.08.09
P2	Revised.	2023.08.18
P3	Revised.	2023.11.02
P4	Revised.	2024.01.22

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Issued by: CH

Contents

1 Executive Summary

1.1.1 MHA was commissioned to prepare a Flood Risk Assessment and Drainage Strategy for the proposed refurbishment of a college building in Belsize Park, Hampstead. The report is required by the London Borough of Camden as part of the planning application process.

1.1.2 There is very low risk of flooding from:

- Rivers and watercourses
- Sea
- Land
- Groundwater
- Sewers
- Reservoirs, canals and other artificial sources
- Previously flood streets.

1.1.3 The primary residual risk that will affect this development is an extreme rainfall event which exceeds the capacity of the proposed surface water drainage system. The risk can be reduced by designing site levels to direct any runoff towards the highways or other corridors running through the site.

1.1.4 Currently the surface water drains via the combined drainage network. Due to existing site layout restrictions, it is infeasible to provide a complete separate drainage system for the surface water.

1.1.5 The existing building's footprint covers the vast majority of the site and does not propose any increase in roof or hardstanding areas. As a result of these constraints opportunities to introduce Sustainable Drainage Strategy (SuDS) measures and achieve greenfield runoff rates are restricted.

1.1.6 To provide some form of sustainability, with all the current constraints considered, a green roof, porous paving and a rainwater garden are being proposed. These SuDS measures will provide the maximum attenuation appropriate to site constraints.

1.1.7 The occupier of the proposed development shall be responsible for the maintenance and operation of the drainage system, including any attenuation and flow control devices.

1.1.8 Following submission of this report to the Council, comments were received from the Local Lead Flood Authority. We worked with the project planning `consultant, to provide responses and to address all comments raised. This Report has therefore been updated since the original planning application submission to include at Appendix C and D the further information submitted to officers during the course of the application. These additional appendices should be read alongside and form part of the Report. Appendix C has also been updated to include the latest Drainage Strategy Layout and Existing and Proposed Drainage Simulation Analysis that was issued to the Council on the 4th of December 2023.

2 Introduction

2.1 Background

2.1.1 MHA was commissioned by Fine Arts College Ltd to prepare a Flood Risk Assessment and associated Drainage Strategy in respect to a proposed refurbishment of an existing three-storey college building in Belsize Park, Hampstead.

2.1.2 As required by London Borough of Camden (the Local Planning Authority) and the Camden Local Plan, this report has been prepared to provide a Flood Risk Assessment and Sustainable Drainage Strategy (SuDS) Plan in support of a planning application.

2.1.3 The proposal is to change the current use which is Class E (Gym/Leisure centre) to F1 (Education – Secondary school).

2.1.4 The proposal is a change of use only and there will be no comprehensive demolition and rebuild. The existing building's footprint covers the vast majority of the site and the existing footprint will remain the same.

2.2 Site Location

2.2.1 The site is located off Belsize Park Gardens Road, London. A Site Location Plan is included in Appendix A .

2.2.2 The Nearest Post Code is NW3 4NJ.

2.3 Topography

2.3.1 The London Borough Camden Topography map (Figure 1, Rev 1) locates our site at 39 to 53mAOD.

2.4 Ground conditions

2.4.1 As the proposal is for the change of use of the building and no comprehensive demolition or rebuild will be undertaken no ground investigation report has been carried out at the time of this report being written.

2.5 Watercourses

2.5.1 No open watercourses are located within 500 metres of the site's vicinity.

2.5.2 A culverted watercourse has been identified in the LB Camden Surface Waterbodies map (Figure 2, Rev 1 from the Camden SFRA 2014 report) approximately 200m to the west of the site. Connection to this culverted watercourse would be infeasible due to crossing multiple 3rd party lands.

2.6 Drainage

2.6.1 As the site has been previously developed, it is anticipated that there is existing drainage on site.

2.6.1 Survey Solutions have carried out a CCTV drainage survey on the 22nd of March 2023 (Report ref.no: 48251CCTV-01). A copy of the CCTV report has been appended within this report.

2.6.2 The CCTV survey has identified an existing combined drainage network which the surface water runoff is currently discharging into.

2.6.3 A copy of the CCTV drainage plan and report has been appended within this report.

2.7 Flood Zones and Vulnerability Classification

2.7.1 The formal flood zone mapping approved by the government and prepared for use in the planning process identifies areas potentially at risk of flooding from fluvial or tidal sources without taking into account the presence of flood defences or structures such as culverts or minor watercourses. An extract from the mapping is included in Figure 1 below; the red marker denotes the site location.

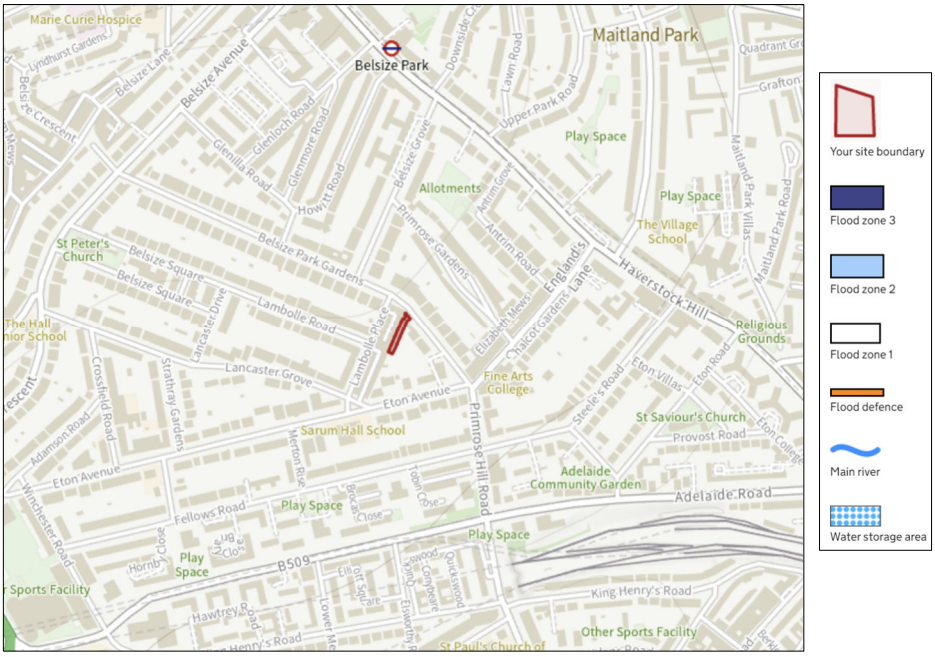

Figure 1: Flooding from Rivers and Watercourses

2.7.2 The formal flood zone mapping shows the site to be located within Flood Zone 1. Table 1 indicates what uses of land are appropriate for each flood zone, as set out within Table 3 – Flood risk vulnerability and flood zone 'compatibility' in the NPPF. The proposed use would be defined as More Vulnerable, hence the proposed use is deemed acceptable.

	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test	✓	✓	✓
Zone 3a	Exception Test	×	Exception Test	✓	✓
Zone 3b	Exception Test	×	×	×	✓

Table 1 - Flood risk vulnerability and flood zone 'compatibility'

2.8 National Planning Flood Risk Policies Relevant to this Development

2.8.1 The National Planning Policy Framework (NPPF) was last revised by the Department of Communities and Local Government (DCLG) on 20th July 2021. This works in conjunction with the Planning Practice Guidance (PPG), published on 6 March 2014.

2.8.2 The requirement for conducting a FRA as part of a planning application is set out in Footnote 55 on page 48 of the NPPF, which states:

"A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."

2.8.3 Essential content of a site-specific FRA is explained in the NPPG, paragraph 20-22 as follows:

"A site-specific flood risk assessment is carried out by (or on behalf of) a developer to assess the flood risk to and from a development site. Where necessary (see footnote 5 in the National Planning Policy Framework), the assessment should accompany a planning application submitted to the local planning authority. The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.

The objectives of a site-specific flood risk assessment are to establish:

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

2.8.4 For certain types of flood sensitive development, NPPF describes how the Local Planning Authority (LPA) should check that the site proposed has the lowest frequency of flooding of those available for the development. This check is called the "Sequential Test". All development that is identified in the LPA's Local Development Framework Development Plan (LDFDP) has been Sequentially Tested using the LPA's Strategic Flood Risk Assessment (SFRA). When a test is required, and the development is not identified in the Development Plan, NPPF advises that the site-specific FRA includes the Test. NPPF also requires that the FRA includes an "Exception Test" for flood sensitive development proposed in areas with high frequency of flooding. The reason is to demonstrate that flood risk will be safely managed for the lifetime of the development.

2.8.5 "Non-Statutory Technical Standards for Sustainable Drainage Systems" published by the Department of Food and Rural Affairs in March 2015 sets out Government expectations for surface water drainage systems.

2.9 Local Policy Guidance

2.9.1 The London Plan, adopted in 2021 is the overall strategy for London's development. This plan provides details on the requirements for London as a whole. The Camden Local Plan, adopted in July 2017, replaces the policies outlined in the Camden Core Strategy and the Camden Development Policies, adopted in 2010. It works in conjunction with the London Plan to present a plan for the future of the borough. As part of this report, the adopted policies have been reviewed, and the proposal has been developed to comply with their requirements. The relevant planning policies are outlined overleaf.

2.9.2 The London Plan Policy SI 12 Flood Risk Management

"A Current and expected flood risk from all sources (as defined in paragraph 9.2.12) across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.

B Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at

reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London.

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

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

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

2.9.3 The London Plan Policy SI 13 Sustainable Drainage

"A Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

B Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
2) rainwater infiltration to ground at or close to source
3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens) 385 The London Plan 2021 - Chapter 9 Sustainable Infrastructure ⊠To table of contents
4) rainwater discharge direct to a watercourse (unless not appropriate)
5) controlled rainwater discharge to a surface water sewer or drain
6) controlled rainwater discharge to a combined sewer.

C Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways. D Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation."

2.9.4 Policy CC2 Adapting to Climate Change

"The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

a) the protection of existing green spaces and promoting new appropriate green infrastructure;
b) not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of SuDS;
c) incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate."

2.9.5 Policy CC3 Water and Flooding

"The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible. We will require development to:

a) incorporate water efficiency measures;
b) avoid harm to the water environment and improve water quality;
c) consider the impact of development in areas at risk of flooding (including drainage);
d) incorporate flood resilient measures in areas prone to flooding;

e) utilise SuDS in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and
f) not locate vulnerable development in flood-prone areas."

2.9.6 The Camden Planning Guidance also provides the Water and Flooding CPG, adopted in March 2019, which provides further details and supports Policy CC3 Water and Flooding in the local plan.

2.9.7 The Council requires that developments must not increase the risk of flooding, and are required to put in place mitigation measures where is known to be a risk of flooding. Major developments will be required to constrain runoff volumes for a 1 in 100 year, 6 hour rainfall event, where feasible. It is also expected to assess the consequences of a 40% uplift in peak rainfall intensity on the drainage network.

2.9.8 A proforma is required to be completed to accompany a drainage strategy prepared for a planning application. It can be found in Appendix D.

2.10 Climate Change Guidance

2.10.1 The Environment Agency released an update in 2022 to the Climate Change Guidance published in 2016.

2.10.2 For flood risk assessments and strategic flood risk assessments, the Environment Agency, as a statutory consultee, uses the management catchment climate change allowances from the peak river flow map as benchmarks.

2.10.3 The development is located in a catchment where the 3.33% and 1% AEP should incorporate 35% and 40% climate change allowance retrospectively.

2.11 Further Guidance

2.11.1 The Sustainability Officer of London Borough of Camden was contacted prior the planning application submission about the development in July. Email correspondence has been appended.

2.11.2 The Sustainability Officer highlighted that any major refurbishments should include a drainage statement which shows how run-off rates are being attenuated to as close to greenfield run-off rates **as feasible given the sites constraints**, this is given particular attention in local flood risk zones/previously flooded streets.

2.11.3 The site constraints that hinder the development from achieving greenfield runoff rates have been discussed in the following sections.

3 Flood Risk

3.1 Flood Risk from Rivers and Watercourses

3.1.1 The site is shown on the available flood maps, see Figure 1 above, to be at a very low risk of flooding from this source as the site is located in Flood Zone 1 and thus has an annual probability of flooding of less than 0.1%. Therefore, the site is not considered to be at risk of flooding from rivers and watercourses.

3.2 Flooding from the Sea

3.2.1 This site is situated approximately 65km from the nearest Sea. Therefore, the risk of flooding from sea is very low.

3.3 Flooding from Land

3.3.1 As indicated in the surface water flood risk map in Figure 2 below, the entire site is located outside any areas of anticipated surface water flood risk.

3.3.2 There is only a very small area allocated as Low risk of flooding from surface water which is believed to be due to the levels within the private car parking area of the Lancaster stables, next to the development site. This should not have any impact on the proposed development.

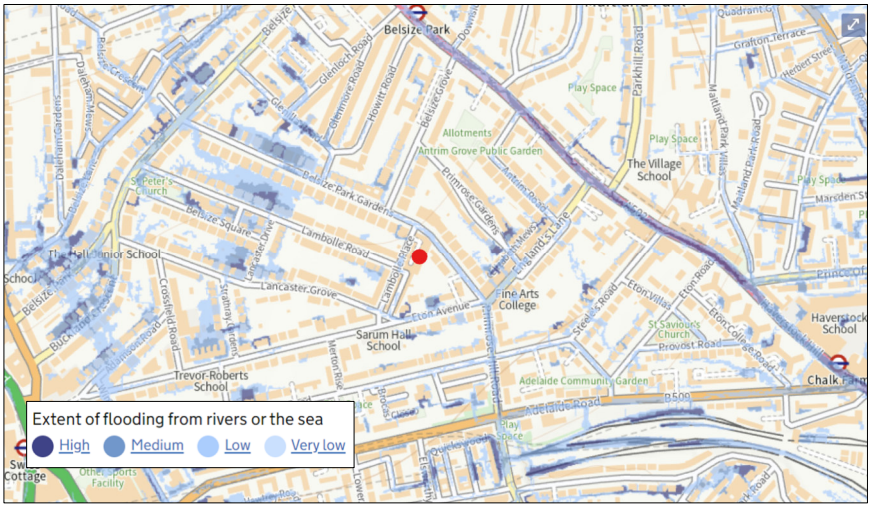

Figure 2: Flooding from Surface Water

3.4 Flooding from Groundwater

3.4.1 The Camden Strategic Flood Risk Assessment have produced a map showing areas with increased susceptibility to elevated groundwater (see figure 3 below).

3.4.2 The map locates the development outside of areas with risk of groundwater flooding and away form previously flooded properties. Therefore, the site is at very low risk of groundwater flooding.

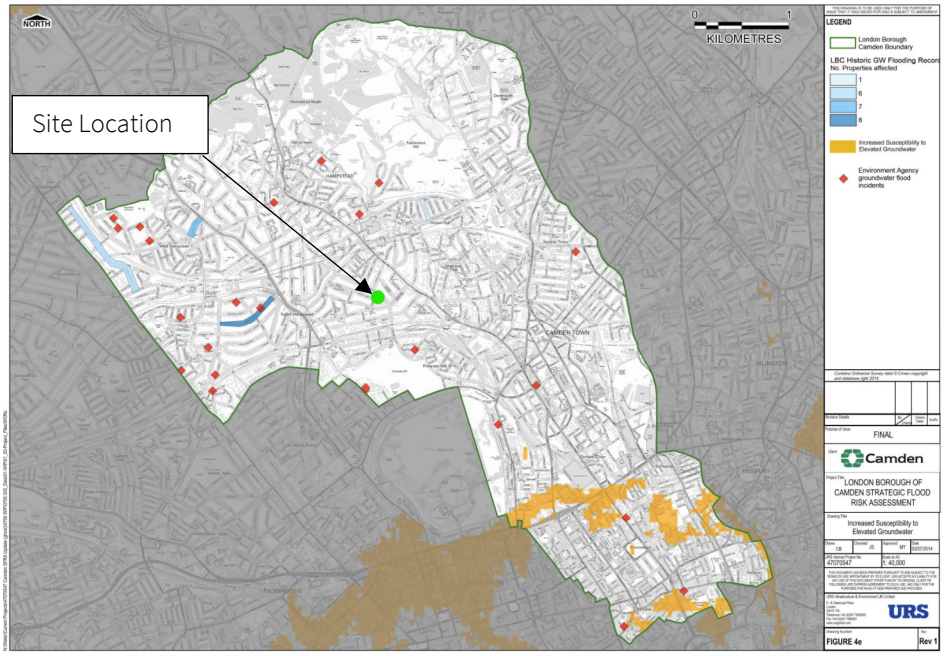

Figure 3: Flooding from Groundwater

3.5 Flooding from Sewers

3.5.1 The Camden Strategic Flood Risk Assessment have produced maps showing areas that have experienced internal and exterior flooding. Figure 4 locates the development outside of areas that have experienced exterior sewer flooding. Figure 5 locates the development within an area that has experienced 1 case of internal sewer flooding.

3.5.2 It is also anticipated that Thames Water regularly provide maintenance to their sewer network reducing the risk.

3.5.3 Therefore, the proposed development is at low risk of sewer flooding.

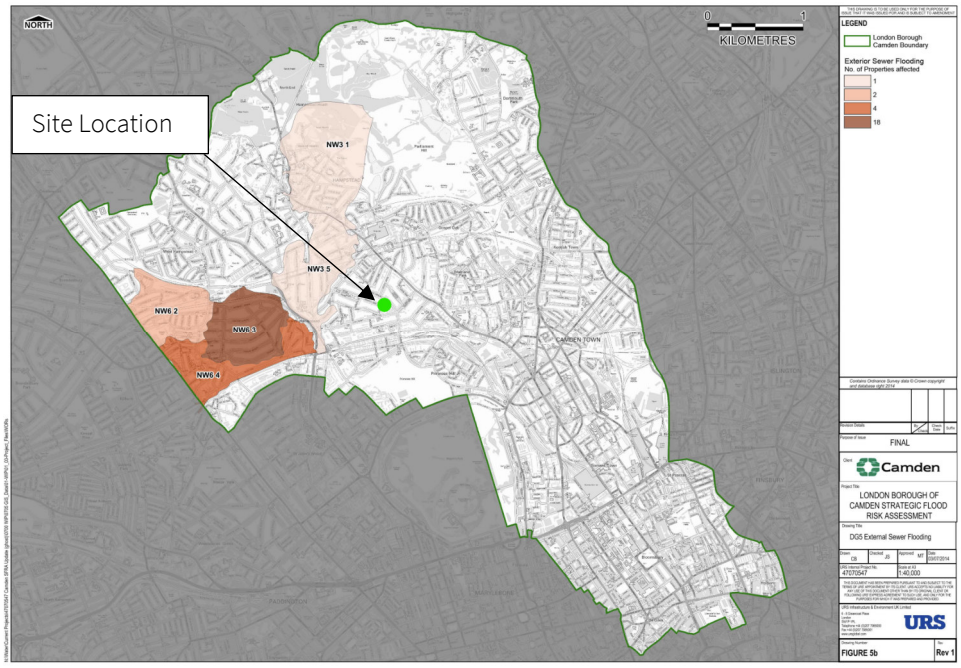

Figure 4: Flooding from Exterior Sewers

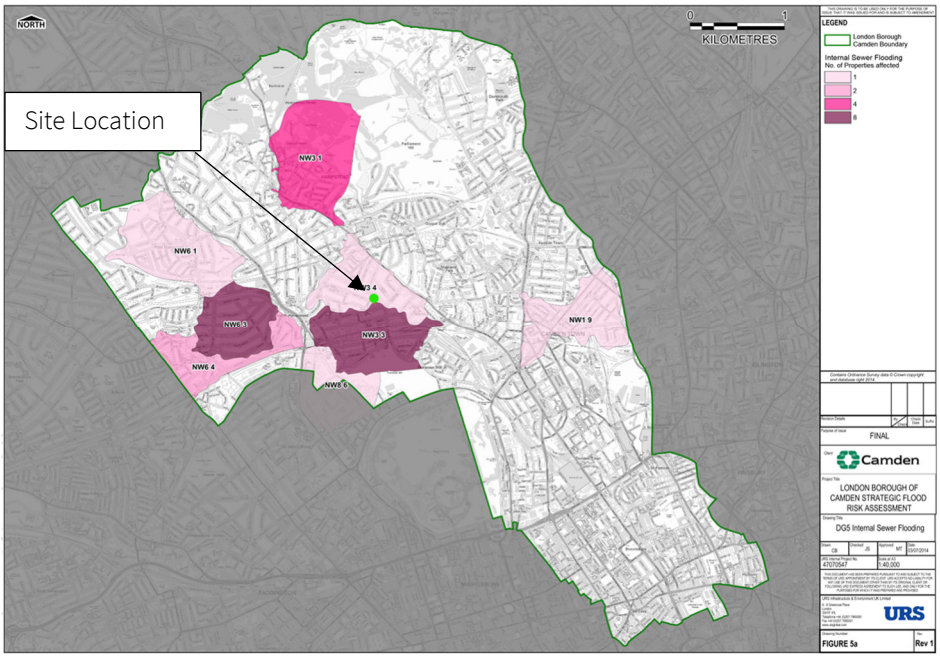

Figure 5: Flooding from Internal Sewers

3.6 Flooding from Reservoirs, Canals and Other Artificial Sources

3.6.1 The reservoir flood map shown in Figure 6 shows the extent of flooding should a canal, reservoir, or other artificial source breach upstream of the development. This shows that the site would not be at risk of flooding from this source and as such this source of flooding is not considered a risk.

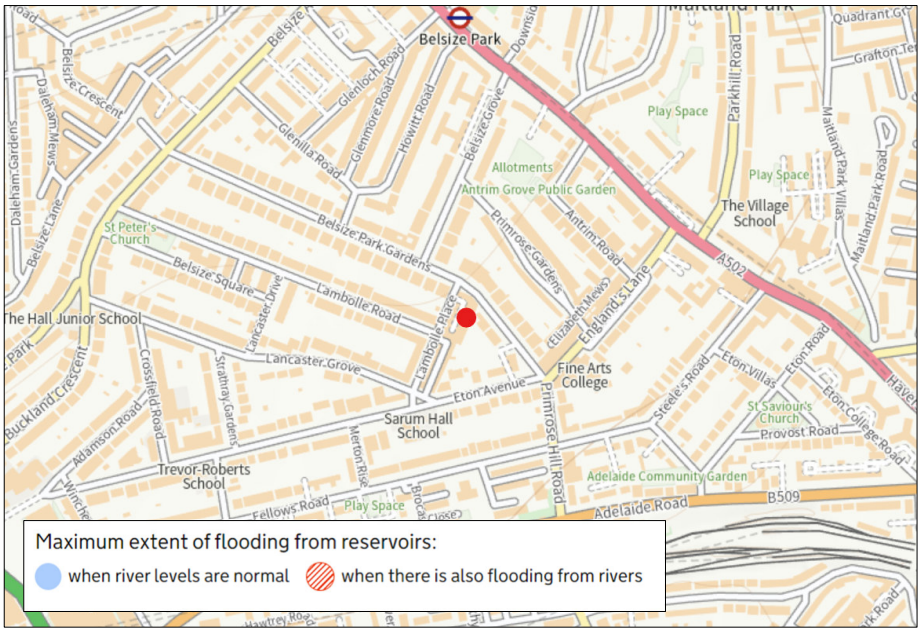

Figure 6: Flooding from Reservoirs

3.7 Previously Flooded Streets

3.7.1 The map shown in Figure 7 shows previously flooded streets. Belsize Park Gardens is identified as having flooded in 1975. It is our understanding that locally flooded streets are treated by Camden in the same way as if they were within one of the Local Flood Risk Zones.

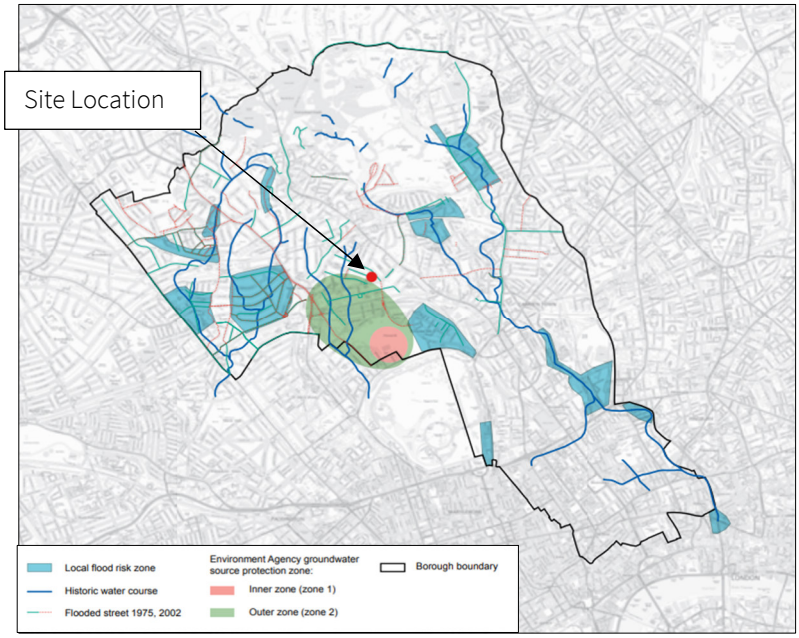

Figure 7: Previously Flooded Streets

3.8 Local Flood Risk Zones

3.8.1 The Camden SFRA also provides a map for the borough's critical drainage areas and local flood risk zones. Figure 8 overleaf shows that the proposed development is in a critical drainage area (CDA) but not in a local flood risk zone (LFRZ). LFRZs are defined as discrete areas of flooding that do not exceed the national criteria for a 'Flood Risk Area; but still affect houses, businesses or infrastructure. CDAs are defined as a discrete geographic area where multiple and interlinked sources of flood risk cause flooding in one or more LFRZs during sever weather thereby affecting people, property or local infrastructure.

3.8.2 Despite being in a CDA, the individual risks discussed in this section do not put the proposed development at significant risk nor does the development significantly increase the flood risks of each type.

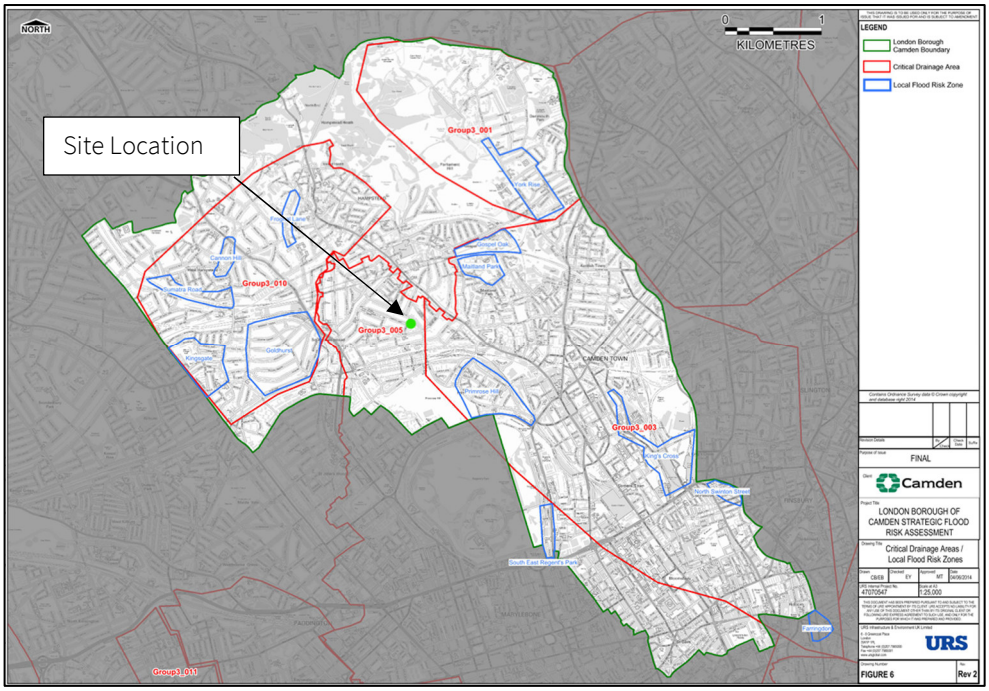

Figure 8: CDAs and LFRZs in the Camden Borough

4 Mitigation

4.1 Flood Risk Management

4.1.1 It is suggested that the following flood risk management measures are considered to mitigate any of the risks identified above:

- Wherever possible, the external ground profile in the development will ensure that surface water is directed away from the existing building.
- The proposed development will incorporate a positive surface water drainage system, described further in Section 4, which will intercept runoff from roofs and paved areas before discharging flows offsite at a rate no higher than the existing values.

4.2 Residual Risks

4.2.1 Residual risks are the risks that remain once the flood risk management measures described above have been implemented. These are typically associated with extreme events that overwhelm drainage systems exceeding the flood levels used to design any mitigation measures. The primary residual risks that will affect this development are:

- An extreme rainfall event which exceeds the capacity of the proposed surface water drainage system to both intercept and convey the flows. During such an event, water that is unable to enter the formal drainage system will flow over the ground through the development. The risk can be reduced by designing site levels to direct any runoff towards the highways or other corridors running through the site.

5 Proposed Drainage Strategy

5.1 Outfall Assessment

As required by Part H of Building Regulations and the paragraph 7-080 in Planning Policy Guidance of the NPPF, the required Drainage Hierarchy has been considered in the development of this strategy as summarised below.

Outfall Option	Available Option	Comment
Storing Rainwater	×	Due to the site layout and existing foundations rainwater harvesting is not feasible. Therefore it has been disregarded.
Infiltration Drainage	×	The use of infiltration outfall has been discounted due to the limited existing external areas and the proximity of the existing foundations.
Open Water Attenuation to Watercourse	×	Watercourses identified in the above sections are infeasible to connect to due to the long distance and 3rd party land permission requirement. There is no available open water feature on site and limited space to introduce one.
Sealed Water Attenuation to Watercourse	×	Watercourses identified in the above sections are infeasible to connect to due to the long distance and 3rd party land permission requirement. Rainwater capture is identified to be unfeasible and storage tanks may cause foundation instability due to their proximity and site layout constraints.
Watercourse	×	Watercourses identified in the above sections are infeasible to connect to due to the long distance and 3rd party land permissions requirement.
Surface Water Sewer	×	The CCTV drainage survey has not identified any existing surface water sewers.
Combined Sewer	✓	It is proposed that the surface water drainage is discharged via the combined network as per the current drainage strategy.

Table 2 – Outfall Assessment

5.1.1 Note that a suitable discharge consent will need to be agreed with the approving body by the contractor prior to completing the connection to the watercourse due to the requirement to provide RAMS.

5.2 SuDS Assessment

5.2.1 As part of the surface water drainage strategy for the site a number of Sustainable Drainage Systems where considered. Table 3 below provides a list of the options considered and a justification for their inclusion or omission.

SuDS System	Used	Justification
Rainwater Harvesting System	No	Due to the site layout and existing foundations rainwater harvesting is not feasible. Therefore it has been disregarded.
Green Roofs	**Yes**	A green roof is proposed to provide a form of attenuation to the existing drainage system. Total area proposed 279m^2.
Infiltration Systems	No	Systems such as soakaways and other infiltration systems are not suitable on this site due the anticipated geology and the limited external space in contrast with the location of existing foundations.

Proprietary Treatment Systems	No	The use of proprietary treatment systems are not considered economically viable or required on this site considering installation and operational costs. Green roofs and permeable paving have been proposed as alternatives.
Filter Strips	No	Filter strips have not been considered the most effective proposal for this site due to the proposed site layout.
Filter Drains	No	Filter Drains have not been considered the most effective proposal for this site due to the proposed site layout.
Swales	No	Swales are not suitable for this scheme due to limited available space and proposed land use.
Bioretention Systems	No	Bioretention Systems have not been considered the most effective proposal for this site due to the lack of available landscape areas.
Porous Pavements	Yes	Porous pavement has been proposed.
Attenuation Storage Tanks (oversized pipes)	No	No attenuation storage can be provided due to the limited external area and the impact of the foundations due to their proximity.
Detention Basins	No	There is insufficient space for a detention basin on this site.
Ponds and Wetlands	No	There is insufficient space for a pond or wetland on this site.
Rainwater Garden	**Yes**	Rainwater garden has been proposed.

Table 3 – SuDS Assessment

5.2.2 It is proposed that suitable features will be provided to support both flood risk and water quality as defined by industry standards and local policies.

5.3 Proposed Surface Water Drainage Strategy

5.3.1 The proposed development which comprises of the change of use of an existing building does not propose any increase in the roof or hardstanding areas. For the reasons explained already in this report as a result of the site constraints and because of the existing building is being retained, restrict the opportunity to introduced SuDS measures and reduce the surface water runoff.

5.3.2 Therefore, it is proposed that the drainage strategy philosophy remains as per the existing, which is to discharge into the existing combined drainage network (as per the CCTV drainage survey), with SuDS measures introduced where feasible.

5.3.3 In order to provide some form of sustainability, with all the current constraints taken into account, a green roof, porous paving and a rainwater garden are being proposed. This will allow to reduce the time of entry of the roof catchment into the network as a form of retention and increase the water quality. Additionally, the proposed SuDS measures improve local biodiversity and amenity.

5.3.4 The proposed drainage system comprising of gutters, down pipes, channels, gullies and a green roof will collect all rainwater on the site from the proposed roof areas, hard landscaping, and discharge into the existing combined drainage network as per the current drainage strategy.

5.3.5 Whilst it is not possible to achieve greenfield runoff rates due to the site constraints and type of development proposed, the SuDS measures will reduce surface water runoff as much as possible in comparison to the current drainage strategy. This is considered to be the most feasible approach for this project.

5.3.6 The existing and proposed and drainage networks have been modelled to reflect the betterment of the proposed drainage network. The full drainage simulation analysis has been appended within this report.

5.3.7 The existing drainage network during the 1% AEP with a 40% climate change allowance shows a flooding of 3.1m^3 and a discharge rate of 18.5 l/s. The proposed drainage network during the 1% AEP with a 40% climate change allowance shows no flooding and a discharge rate of 12.9 l/s. The difference in the flooding and the discharge rate is a direct result of the proposed SuDS features provided.

5.3.8 A copy of the proposed drainage strategy has been appended within this report.

5.3.9 Camden's drainage proforma has been completed and appended within this report.

5.4 Exceedance Flows

5.4.1 As discussed previously in Section 3.2, a potential source of overland flooding on the site is failure of the surface water drainage system or a rainfall event in excess of the systems or surrounding areas design parameters. In this instance, this would correspond to a storm event more severe than the design storm of 1 in 100 years (+40% climate change).

5.5 Foul Water Drainage Strategy

5.5.1 The CCTV drainage survey identified a combined drainage network that serves the existing building. It is proposed that this is to remain with only the internal foul drainage points to be amended to suit the new internal layout of the building.

6 Drainage Management Plan

6.1 Responsibility

6.1.1 The occupier of the proposed development shall be responsible for the maintenance and operation of the drainage system, including any attenuation and flow control devices.

6.2 Maintenance of Pipe Networks

6.2.1 Maintenance and management of main storm sewers and chambers inclusive of pipework from paved areas and buildings (but excluding internal building drainage) should be visually inspected and jetted/cleaned as required. As a minimum, this should be carried out every 5 years. Methods of inspection to give indications of blockages etc. may include:

- Pulling a mandrel through the pipe to identify physical faults (e.g. disjointed pipes).
- Flushing/jetting.
- CCTV.
- Measurement of water depths in pipe entries, catchpits or interceptors along a drain run may identify potentially blocked pipes.

6.2.2 Gully gratings, manhole gratings and channel gratings shall be visually inspected at least once every year and replaced or re-set if damaged or dislodged. Gullies should be inspected at least once every year, ideally during spring time as the autumn and winter seasons produce the most detritus build up in the form of leaves, litter and silt. This material should be removed from the channels and disposed of at a licensed tip. This material should not be tipped in other areas of the development as it may pose a pollution threat to the surrounding drainage system.

6.2.3 Jetting should only be carried out after removal of the silt and debris, as jetting alone will simply wash the debris further downstream without removing the problem.

6.3 Maintenance of SuDS Features

6.3.1 The regular and correct maintenance of the SuDS feature is essential to the continued performance. The SuDS Manual C753 provides advice on the management of the system. The recommended maintenance regimes for the green roof is given in Table 12.5 in the SuDS Manual C753 respectively, which will form the basis of the strategy for the provided development. A copy of this table is provided overleaf.

6.3.2 A rainwater garden requires minimal maintenance other than monthly inspections and cleaning the inlet and outlet after storm events or when necessary. Remove weeds and invasive species if needed. Monthly inspections can be reduced to quarterly inspections after a year of standing. Repair erosion when needed.

6.3.3 Porous paving should be pressure washed at least biannually to alleviate clogs and remove sediment. It should also be inspected after any storm event to ensure that rainwater still infiltrates as intended.

6.3.4 A copy of this table is provided below.

TABLE 12.5 Operation and maintenance requirements for green roofs

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), 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	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
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
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

Table 5 – Table 12.5 CIRIA 753

TABLE 20.2 Evidence of durability and clogging of the surfaces of pervious pavements

Pervious pavement type	Clogging mechanism	Evidence of likely clogging rates/extents	Rehabilitation mechanisms
Grass reinforcement (concrete grids)	Sand-filled voids with grass overgrowth act like sand filters and trap sediment close to the surface	Clogging depths of 6–12 mm (Urban Waterways, 2011); loss of 60–75% of the initial surface infiltration rate during a simulated 35-year life (Jayasuriya *et al*, 2007)	Clogged sand can be removed and replaced with mechanical sweepers, although the grass will also have to be reseeded
Porous asphalt	Dust and sediment trapped in surface pores	Clogging in the top 25–75 mm can occur rapidly without good design and maintenance, where silt loads are significant. Evidence in the UK is that pavements are still serviceable after about eight years	Rotating sweeper and jet wash; use a surface layer with finer pores (ie smaller aggregate) and increasing aggregate size with depth (Beeldens and Herrier, 2006)
Porous concrete	Dust and sediment trapped in surface pores	Clogging in the top 25–75 mm can occur rapidly without good design and maintenance, where silt loads are significant	Use a surface layer with finer pores (ie smaller aggregate) and increasing aggregate size with depth (Beeldens and Herrier, 2006); specialist rotating and oscillating sweeper (the type used to remove tyre residue from airport runways
Concrete block permeable paving	Dust and sediment is trapped in the joints between the blocks	Penetration to 50 mm (over six years) (Urban Waterways, 2011); loss of 70–90% of as-new surface infiltration rate over the first few years of use after which infiltration rate levels off and remain effectively constant (Borgwardt, 2006); in heavily trafficked pavements the wheel tracks may become completely clogged in a few years (Chaddock and Nunn, 2010)	Brushing and suction sweeping of the surface, replacement of top 20 mm of jointing material, herbicide application and weed removal programmes

Table 6 – Table 20.2 of CIRIA 753

6.3.5 It should be noted that maintenance regimes detailed above are initial recommendations and the actual maintenance work undertaken should be adapted to suit the system performance by the maintenance provider.

7 Conclusion

7.1.1 This site-specific Flood Risk Assessment and drainage strategy has been prepared in accordance with NPPF guidance and local policy on Flood Risk. The government approved flood mapping shows the site to be located within Flood Zone 1 and thus at a low flood risk from both fluvial and pluvial sources on the site. Further to this, the proposed levels on the site shall be set such that in the unlikely event of these systems failing the development on the site will remain protected.

7.1.2 The proposed roof and external hardstanding areas are proposed to remain the same, with the exception of the roof; Green roofs, porous paving and rainwater garden will be proposed as a SuDS measure.

7.1.3 Currently the surface water drains via the combined drainage network as identified in the CCTV drainage survey. Due to existing site layout restrictions and because the proposed development comprises of the conversion of an existing building, resulting in the footprint which covers the majority of the site, it is infeasible to provide a complete separate drainage system for the surface water. Therefore, the proposal is to follow the current philosophy of discharging the surface water via the combined drainage system with SuDS measures introduced where feasible to manage surface water runoff.

7.1.4 A hydraulic simulation analysis has been carried out and the results have been appended within this report, see appendix C.

7.1.5 Following submission of this report to the Council, comments were received from the Local Lead Flood Authority. We worked with the project planning consultant, to provide responses and to address all comments raised. This Report has therefore been updated since the original planning application submission to include at Appendix C and D the further information submitted to officers during the course of the application. These additional appendices should be read alongside and form part of the Report. Appendix C has also been updated to include the latest Drainage Strategy Layout and Existing and Proposed Drainage Simulation Analysis that was issued to the Council on the 4th of December 2023.

Appendices

Appendix A - Existing and Proposed Site Plans, Site Location Plan

Appendix B – CCTV Drainage Survey

Appendix C - Proposed Drainage Strategy, Supporting Calculations & Correspondence

Appendix D – Further Submitted Information