Flood Risk Assessment

&

SUDS Statement

in connection with the proposed development at

133 Arlington Road

London

NW1 &ET

for

Grant Parkinson & Masha Feigelman

LBH4501suds Ver. 1.0

September 2018

LBH WEMBLEY

ENGINEERING

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1. Introduction

1.1 Background

It is proposed to both deepen and extend the lower ground floor of 133 Arlington Road.

In order to facilitate a greater floor height it is proposed the existing lower ground floor level is deepened by approximately 400mm, following which both the ground and lower ground floors will be extended to the rear

This rear extension will involve excavation of the existing patio area in order to lower it to the level of the proposed lower ground floor.

The proposed redevelopment will also involve minor alterations to the internal layout of the building.

This drainage report has been prepared to support a Basement Impact Assessment (LBH4501 Ver. 1.1 dated 23rd January 2018) prepared for the London Borough of Camden.

A Flood Risk Assessment (FRA) is required in order to assess the potential for the development to increase flood risk elsewhere through the addition of hard surfaces and the potential effect of the new development on surface water run-off, in addition to assessing the site vulnerability to flooding from other sources including groundwater and overland runoff, rivers and the sea.

The purpose of this report is to assess the existing flood risk, including mitigation measures and whether the site is suitable for residential usage. The report identifies whether there are any flooding or surface water management issues, whether the site lies within an area that is at risk of flooding or whether the development may increase flood risk due to increased run-off. This is achieved through Identification of the sources of flooding which may affect the site, and includes the following:-

- An appraisal of the availability and adequacy of existing information
- A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere
- An appraisal of the scope of possible measures to reduce the flood risk to acceptable levels

The report will demonstrate to the Local Planning Authority (LPA) that the applicant is considering flood risk to the development from all sources and how this will be managed. The assessment also considers the disposal of drainage water, potential impacts on adjacent land and climate change effects.

The assessment has been based on existing reports and archive information together with information from historical maps and photographs.

1.2 Site-Specific Flood Risk Assessment

The Camden Local plan provides guidance for water and flooding under Policy CC3, where the council will seek to ensure a development reduces the risk of flooding where possible and will require a 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 Sustainable Drainage Systems (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.*"

Additionally, the Camden Planning Guidance for Sustainability (CPG3) (July 2015, updated March 2018) states:

"*All developments are expected to manage drainage and surface water on-site or as close to the site as possible, using Sustainable Drainage Systems (SUDS) and the hierarchy set out below.*

The Council will expect plans and application documents to describe how water will be managed within the development, including an explanation of the proposed SUDS, the reasons why certain SUDS have been ruled out and detailed information on materials and landscaping.

The Council will expect developments to achieve a greenfield surface water run-off rate once SUDS have been installed. As a minimum, surface water run-off rates should be reduced by 50% across the development."

2. The Site

2.1 Site Location

The site is situated on the eastern side of Arlington Road, placed approximately 250m south of the Camden Town London Underground Station.

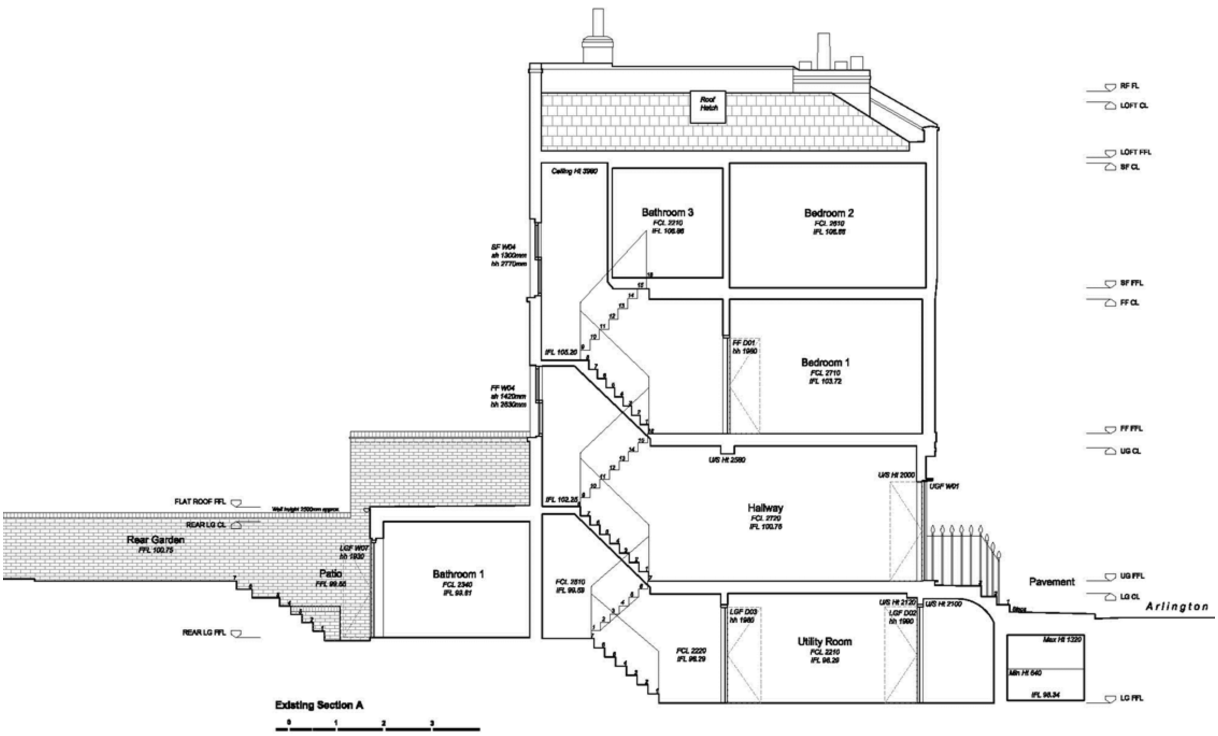
The site may be located approximately by postcode NW1 7ET, or by National Grid Reference 528970, 183510.

2.2 Topographical Setting

The site lies at approximately +31m OD on a relatively gentle slope falling to the northeast towards the valley of the River Fleet.

2.3 Site Description

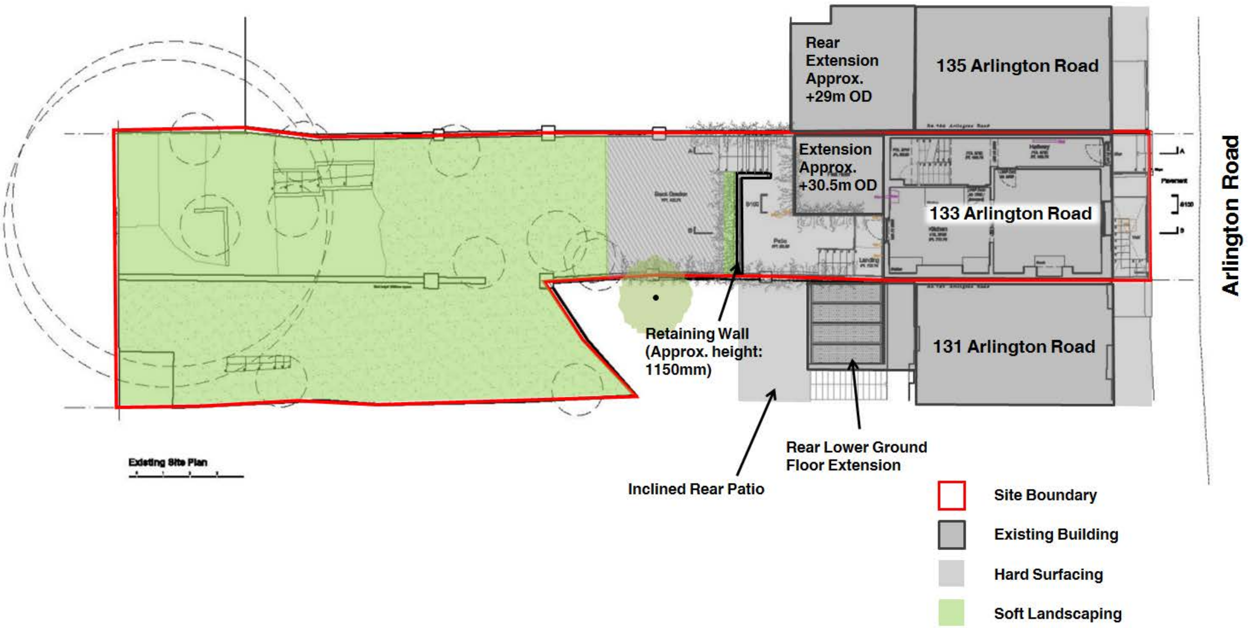
The site is currently occupied by a four-storey terrace house with ground floor and lower ground floor levels set at approximately +31.5m OD and +29m OD, respectively. An extension is present to the rear of the property at an intermediate level between the lower ground and ground floors, at approximately +30.5m OD. The extension comprises half the width of the property and consists of a single bathroom. A section drawing showing the current floor layout is shown below.



No 133 has evidently been constructed slightly differently to the adjacent buildings, having a different original layout to both the front and rear.

The rear garden of the property comprises a patio set at the intermediate floor level of the rear extension, from which steps lead up to a timber decking area at ground floor level.

Further to the rear, the remaining garden is soft landscaped. A soft landscaped, albeit overgrown, area to the southeast, formerly the garden of No 131, is now also part of the site.



Site plan showing existing features

The site is adjoined to the northwest and southeast by terraced houses at No 135 and No 131 Arlington Road, respectively. The adjacent No 135 includes a lower ground floor extension set at a similar level to the lower ground of No 133.

A lower ground extension is also present to the rear of No 131 Arlington Road and again this appears to be set at a similar level to the existing lower ground floor of No 133. A patio, set at lower ground level, is also present behind the extension, extending to a similar distance to the rear as the patio at No 133.

The rear of the garden to the southwest is bordered by the rear gardens of the properties fronting Albert Street.

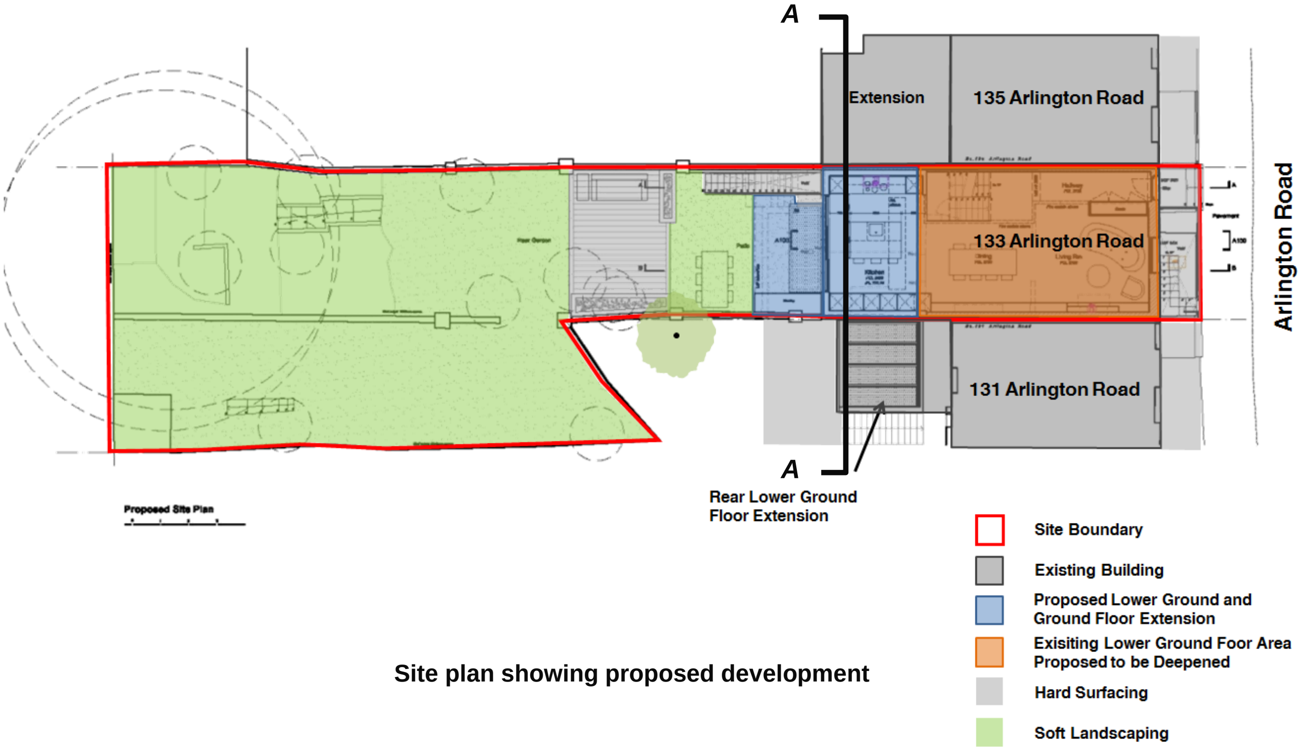
The site has a total drained area of approximately 0.01 ha.

Above: View of the rear garden

Left: View of the rear elevation

2.4 Proposed Development

Following demolition of the existing extension, it is proposed to extend the lower and upper ground floors to the rear of the building, with associated roof lights to the rear of the new extension. The existing lower ground floor level beneath the entire footprint of the building will also be lowered by 400mm, therefore requiring an excavation of approximately 1m.



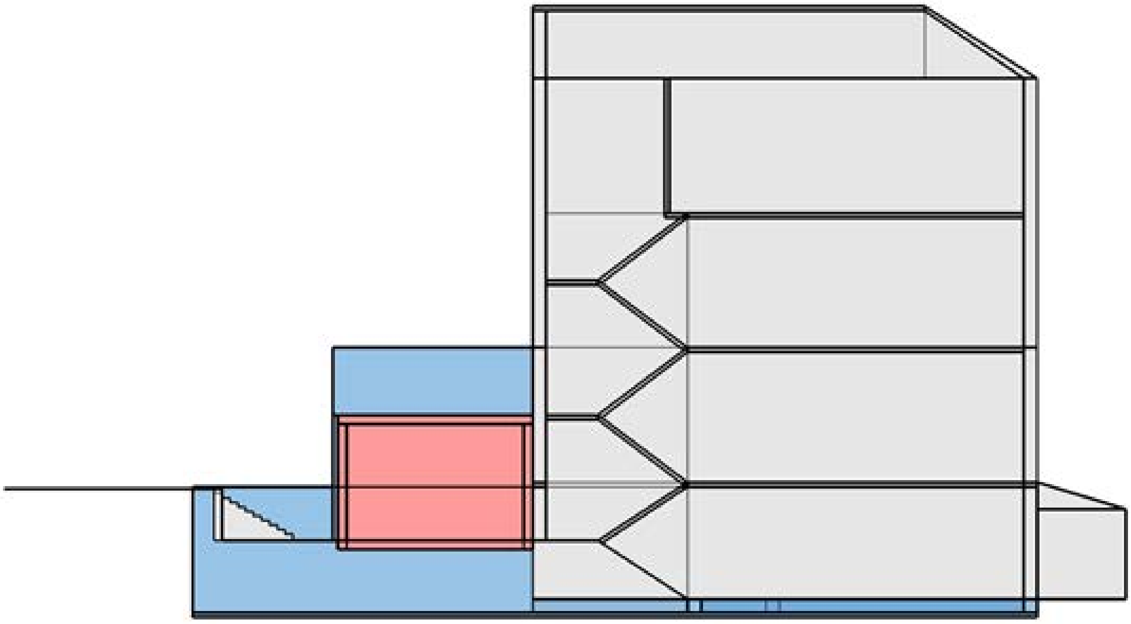
Site plan showing proposed development

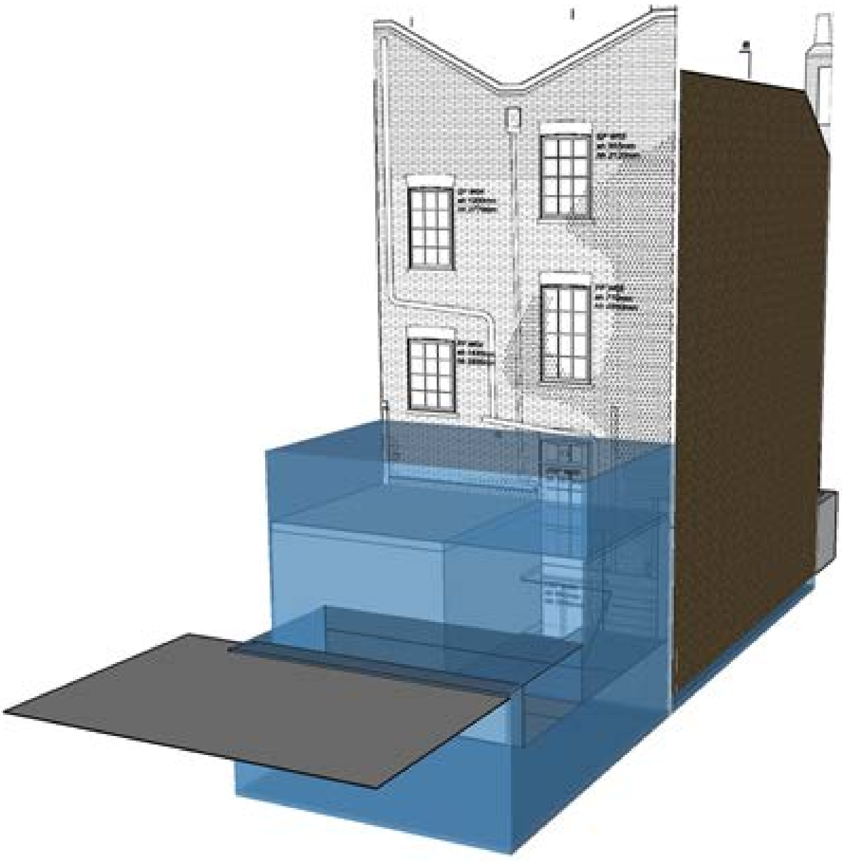
Section (A-A) drawing showing proposed rear extension (blue) against the assumed extent of the existing adjacent extensions

The proposed ground floor will laterally extend approximately 3.5m away from the main building, coincident with the ground floor extension at the neighbouring 135 Arlington Road.

The proposed lower ground floor is proposed to extend roughly 2m further into the rear patio area, creating space for a playroom. As well as internal access, the lower ground floor will be accessed via a staircase from the rear garden.

The basement slab of the lower ground floor across the entire proposed footprint will be set 0.4m below the existing lower ground floor.





Visualisation of the proposed development
(showing proposed demolition in red and basement extension in blue)

3. Flood Risk Assessment

The Department for Communities and Local Government have published their online Planning Practice Guidance (PPG) that supersedes the National Planning Policy Framework Technical Guidance of March 2012. The following section has been prepared in accordance with the PPG.

3.1 Existing Flood Alleviation Measures

No evidence of any existing alleviation measures in the vicinity of the site has been identified.

3.2 Flood Risk Vulnerability Classification

The property is residential and therefore Table 2 of the Planning Practice Guidance (PPG) indicates that the site is classified as 'More Vulnerable'.

3.3 The Sequential Test

The PPG requires that the risk based sequential test should be applied at all stages of planning, which aims to steer new development to areas at the lowest probability of flooding (Flood Zone 1). It is also recognised that some areas will also be at risk of flooding from sources other than tidal and fluvial.

As shown on the Environment Agency (EA) flood map of flood risk from rivers and the sea, the site is locately entirely within Flood Zone 1. In addition, the EA flood map of surface water flood risk indicates the site to be up to a medium risk of surface water flooding, however there is not the opportunity to move the site to a lower probablity of surface water flooding.

3.4 The Exception Test

Table 3 of the PPG does not require the Exception Test to be applied given that in Flood Zone 1 "*Development is appropriate*".

4. Hazard Identification

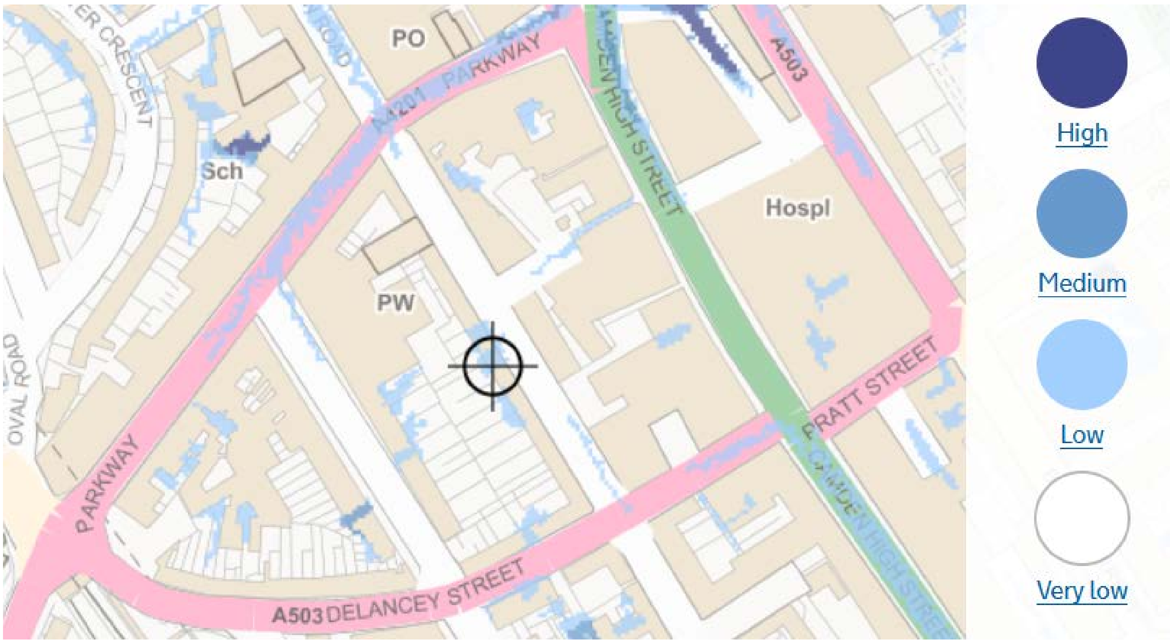
4.1 Flooding from Rivers and the Sea

All main rivers located within the London Borough of Camden are culverted and are incorporated into the Thames Water sewer network, as a result, the London Borough of Camden is located entirely within Flood Zone 1 This indicates that the assessed annual probability of flooding at the site is less than 1 in 1000 (<0.1%).

In addition, the Camden SFRA records that no flooding has occurred within the borough from fluvial or tidal sources.

4.2 Flooding from Land

The EA's Surface Water Flood Map indicates that the site itself is at a low risk of flooding from surface water (0.1% to 3.3% AEP).



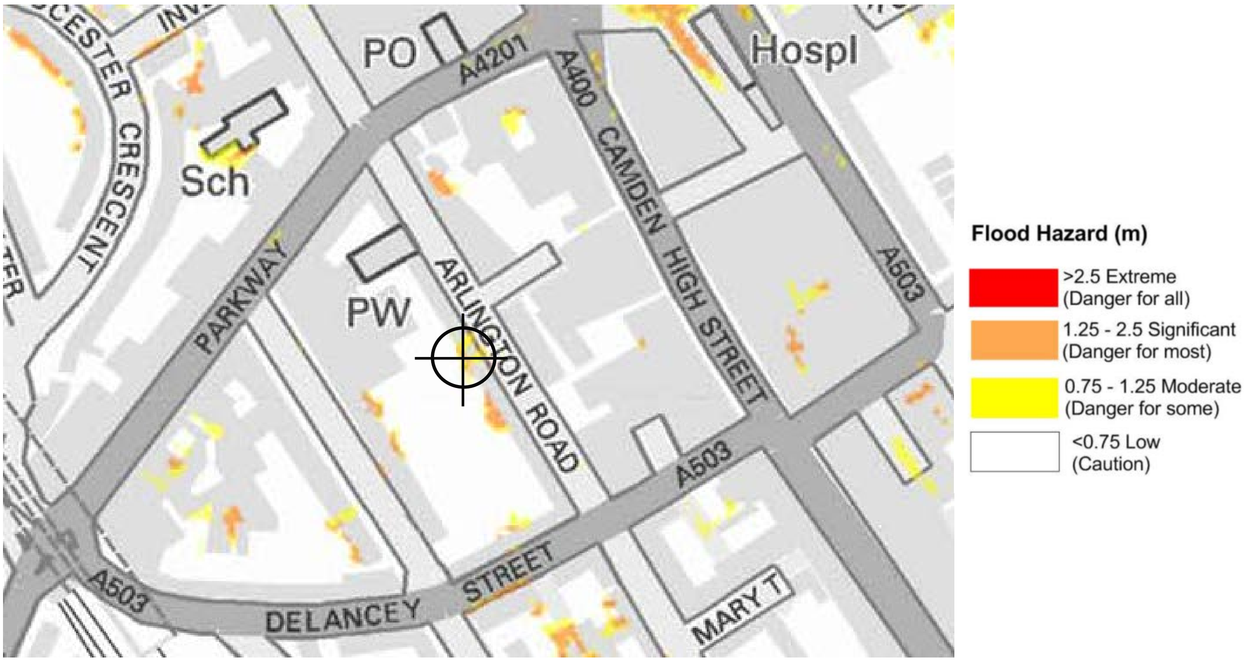
Extract of the EA's Surface Water Flood Risk Mapping map showing the flood risk from surface water

Hazard mapping created by the EA indicates the hazard to people following a methodology presented by Defra in its R&D report on Flood Risks to People[1].

[1] *Defra (2006) Defra Guidance Document FD2321/TR2: Flood Risks to People*

The following map indicates that even in the event of a 1 in 1000 rainfall event (<0.1%), the surface water flood hazard within the surrounding area of the site is classed up to Extreme (Danger for all) to the rear of the property, however the property itself is classed as Low (Caution)

Historic flood records indicate that the London Borough of Camden experienced significant flooding in 1975 and 2002. Kentish Town Road was affected by surface water flooding during the 1975 flood event.



Extract of Figure 3 ix: Hazard 1 in 1000 year flood event (Camden SFRA, 2014)

Figure 6 of the SFRA indicates the site is located within Critical Drainage Area (Group 3_003), which is identified as an area at risk of surface water flooding.

4.3 Flooding from Groundwater

Groundwater flooding occurs when water levels within the ground rise above surface levels.

The British Geological Survey (BGS) records indicate that the site is underlain by the London Clay Formation, which the Environment Agency (EA) classifies 'Unproductive Strata'.

No groundwater was encountered during the investigation and no shallow groundwater table is considered to be present at this site.

The site does not lie within an area that is deemed to be at an increased susceptibility to elevated groundwater and it is concluded that the risk of groundwater flooding at the site is very low.

4.4 Flooding from Sewers

The SFRA indicates that in the postcode NW1 7 there were no records of properties experiencing sewer flooding.

The site is considered to be at a very low risk of sewer flooding.

4.5 Flooding from Reservoirs, Canals and other Artificial Sources

The EA's Reservoir Flood Map identifies areas that could be flooded if a large reservoir were to fail or release the water it holds. The map shows that the site lies outside the area at risk of reservoir flooding, with the nearest area at risk of flooding being the Grand Union Canal.

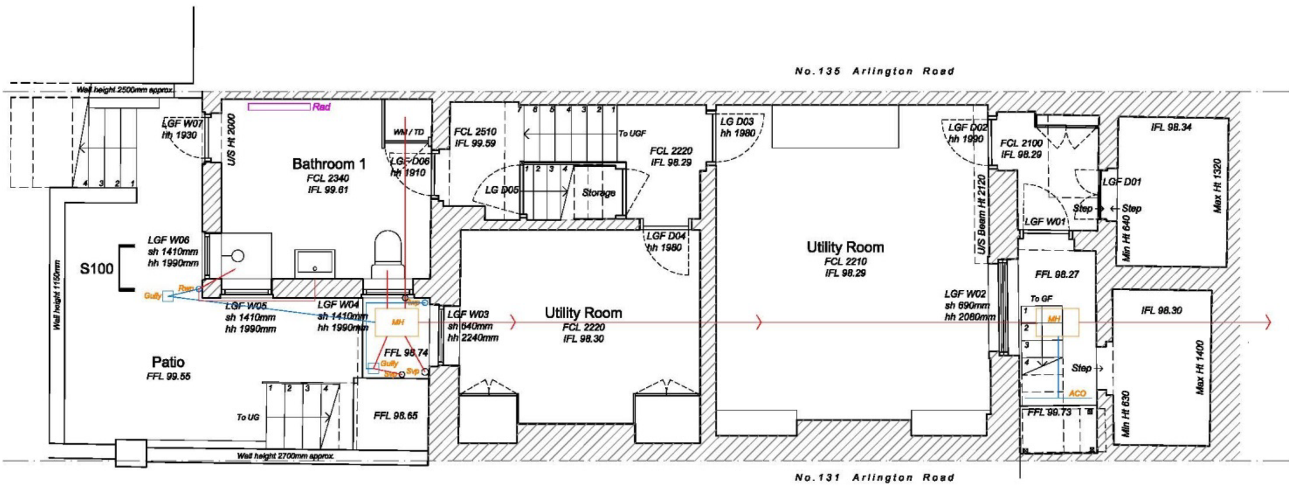
The SFRA has not identified any other significant artificial sources of flood risk within the borough that may adversely affect the site.

5. Surface Water Management (SWM)

5.1 Site characteristics

Thames Water records show a 1500mm x 900mm combined sewer running southwards beneath Arlington Road with an invert at approximately +24.0m OD (7m depth).

Rainfall incident on the roof is collected via pipework down the rear of the property, where it discharges to a drain running beneath the property to the combined sewer in the street.



The site is directly underlain by the London Clay Formation and therefore infiltration is not suitable for the proposed development.

5.2 Ground Investigation

An investigation by means of small diameter percussive boreholes was carried out in November 2017, in order to assess the ground conditions.

The investigation indicates beneath shallow made ground, the site is directly underlain by the London Clay Formation.

No shallow groundwater table is present beneath this site.

5.3 SWM objectives for the development

The drainage strategy follows the guidance from the 2015 CIRIA C753 SUDS Manual; the principle of SUDS design is that surface water runoff is managed for maximum benefit. The types of benefits that may be achieved by utilising SUDS are categorised by the design objectives outlined in the following section.

5.3.1 Water quantity

The design objective is to control the quantity of runoff to support the management of flood risk and maintain and protect the natural water cycle.

In order to ensure that the surface water runoff from a developed site does not have a detrimental impact on people, property and the environment, it is important to control the rate and volume of the discharge from the site.

Sustainable Drainage Systems (SuDS) should be incorporated into the design of a development unless there are practical reasons for not doing so. In aiming to achieve greenfield runoff rates, surface water runoff should be managed using the following techniques, as outlined in order of priority by the following drainage hierarchy:

SUDS Drainage Hierarchy	Suitable for the site? (Y/N)	Comment
Store rainwater for later use	N	There is very limited space for a gravity driven system within the property or a pumped solution within the garden.
Use infiltration techniques	N	The site is directly underlain by the London Clay, inhibiting infiltration on the site.
Attenuate rainwater in ponds or open water features for gradual release	N	No ponds of open water features nearby.
Attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Attenuation storage will be provided by a green roof located on the flat roof above the rear extent of the ground floor.
Discharge rainwater direct to a watercourse	N	No nearby watercourse.
Discharge rainwater to a surface water sewer/drain	N	No surface water sewer is serving the site.
Discharge rainwater to the combined sewer	Y	Discharge to existing combined sewer serving the site.

The hierarchy above seeks to ensure that surface water runoff is controlled as near to its source as possible to mimic natural drainage systems and retain water on or near to the site.

Before disposal of surface water to the public sewer is considered, all other options set out in the above hierarchy need to be exhausted.

5.3.2 Water quality

The water quality design objective is to manage the quality of runoff to prevent pollution, supporting the management of water quality in the receiving surface waters and groundwater and design system resilience to cope with future change.

Surface water runoff will need treatment where necessary to meet the appropriate water quality requirements for the method of discharge.

5.3.3 Amenity

The amenity design objective is to create and sustain better places for people by implementing the following criteria for the site:

- Maximise multi-functionality
- Enhance visual character
- Deliver safe surface water management systems
- Support development resilience/adaptability to future change
- Maximise legibility
- Support community environmental learning

5.3.4 Biodiversity

The biodiversity design objective is to create and sustain better places for nature by implementing the following criteria for the site:

- Support and protect natural local habitats and species
- Contribute to the delivery of local biodiversity objectives
- Contribute to habitat connectivity
- Create diverse, self-sustaining and resilient ecosystems

5.4 Conceptual Drainage Plan

The following sections set out the presently envisaged proposals for drainage components.

5.4.1 Feasible Discharge routes

The surface water runoff from the roof will be stored and directed to the combined sewer.

5.4.2 Feasible Drainage Components

SUDS Component	Description	Suitable for the site? (Y/N)
Rainwater harvesting	Collection of rainwater runoff from roofs or impermeable areas for reuse.	N
Green roofs	Vegetated areas installed on the top of buildings provide visual and ecological benefits in addition to surface water runoff reduction and enhanced building performance.	Y
Blue roofs	Roof design intended to store water providing attenuation storage.	N
Infiltration systems	Infiltration can contribute to reducing runoff rates and volumes while supporting base flow and groundwater recharge processes.	N
Proprietary treatment systems	Proprietary treatment systems are manufactured products which remove specified pollutants from surface water runoff.	N
Filter strips/drains	Filter strips are gently sloping strips of grass that provide treatment of runoff from adjacent impermeable areas. Filter drains are gravel or stone filled trenches which provide temporary subsurface storage for attenuation conveyance and filtration of surface water runoff.	N

Swales	Swales are shallow, flat bottomed, vegetated open channels designed to convey, treat, and attenuate surface water runoff.	N
Bioretention systems	Rain gardens or shallow landscaped depressions that may reduce surface water runoff rates and volumes and/or treat pollution using engineered soils and vegetation.	N
Trees	Trees aid surface water management through transpiration, inception, infiltration and phytoremediation.	N
Pervious Pavements	Pervious pavements facilitate the infiltration of surface water into a subsurface structure where filtration, adsorption, biodegradation or sedimentation may also provide treatment of the runoff.	N
Attenuation storage tanks	Attenuation storage tanks provide below-ground void space for the temporary storage of surface water before infiltration, controlled release or use.	N
Detention basins	Attenuation storage in the form of dry landscaped depressions.	N
Ponds and wetlands	Permanent water filled ponds or wetlands that provide attenuation storage or treatment of surface water runoff.	N

5.4.3 Water Quantity

Runoff rates and volumes will be reduced by the incorporated green roof through the uptake of water into the soil substrate and plants, where the potential reduction will be a function of the soil moisture content, soil depth and roof gradient.

5.4.4 Water Quality

The soil and uptake zone of the green roof will filter airborne pollutants and pollutants within rainwater, reducing the amount of pollution delivered to the local drainage system.

5.4.5 Amenity

The proposed green roof will be over looked by the flats present on the upper floors of the property and the surrounding buildings, providing valuable amenity in a densely urban area.

5.4.6 Biodiversity

The green roof will act as a “stepping stone” or “island” habitat providing ecological value in a highly urbanised area.

It is recommended that a sufficient depth of substrate is used on the green roof (no less than 80mm) and the topography is varied (80mm-150mm) in order to provide a range of habitats for invertebrates.

5.4.7 Maintenance

Suds Component	Maintenance	
Green Roofs	Regular inspections (Annually or after storms)	• Inspect all components including soil substrate, vegetation, drains, irrigation systems, membranes and roof structure for proper operation, integrity of waterproofing and structural stability. • 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 (Biannually)	• Remove debris and litter to prevent clogging of inlet drains and interference with plant growth. • During establishment (ie year one), replace dead plants as required (Monthly) • Post establishment, replace dead plants as required • Remove nuisance and invasive vegetation, including weeds. • Mow grass as required, and clippings should be removed.
	Remedial action (As required)	• If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion should be controlled. • If drain inlet has settles, cracked or moved, investigate and repair as appropriate.

Maintenance plans and schedules should be prepared in the design phase for the specific maintenance needs of each SUDS component, and necessary adjustments made to suit requirements.

5.5 Outline Design

5.5.1 Greenfield runoff rate

$$Q_{bar}(m^3/s) = 0.00108(0.01 \times AREA)^{0.89} \times SAAR^{1.17} \times SPR^{2.17}$$

Qbar - mean annual flood flow from a rural catchment (approximately 2.3 year return period).

AREA- area of the catchment in ha.

SAAR - standard average annual rainfall for the period 1941 to 1970 in mm (SAAR 41-70).

SPR - Standard Percentage runoff coefficient for the SOIL category.

Return Period	Greenfield runoff rate (l/s/ha)	Runoff volume in 6 hour storm event (m^3)
1 in 1 year	0.04	0.009
1 in 30 year	0.10	0.022
1 in 100 year	0.13	0.028

5.6 Existing runoff rate

The existing layout is currently approximately 100m^2 impermeably surfaced.

The runoff of the impermeable area can be calculated using the Modified Rational Method:

$$Q = 2.78 \text{ x } C.i.A$$

Where Q = flow (l/s), i = rainfall intensity (mm/hr), A = Contributing area (ha) and $C = C_v.C_r$.

Typically $C_v = 0.75$ and $C_r = 1.3$, therefore C=0.98.

For the case of the impermeable area on the existing site i =10.5 mm/hr, the rain intensity during a 1 in 100 year 6 hour event and A = 100m^2. As a result the site s will experience a runoff rate of 0.29l/s and a runoff volume over the 6 hour period of 6.18m^3.

5.7 Proposed Runoff Volumes

Given that there will be no increase in impermeable area post-development it is envisaged that runoff rates from the site would remain unchanged.

Although no increase in runoff is anticipated as a result of the development, there is a potential increase in runoff associated with future climate change.

To mitigate the potential increase in runoff volume in the case of a storm event, the drainage strategy follows the guidance from the 2015 CIRIA C753 SUDS Manual.

5.7.1 Attenuation storage

In order to limit the discharge rate to the surface water sewer serving the site, attenuation storage is to be included as a SuDS element.

HR Wallingford's Surface water storage volume estimation tool has been used to undertake attenuation storage volume calculations, using the site specific rainfall data from the Centre for Ecology and Hydrology (CEH) and an FEH/FSR Conversion Factor of 1.33; i.e. Flood Studies Report (FSR) rainfall data is 33% larger than Flood Estimation Handbook (FEH) rainfall data for this location. These calculations indicate that no attenuation storage is required to maintain greenfield runoff rates for the 1 in 100 year rainfall event in consideration of up to 40% climate change allowance.

5.7.2 Proposed Drainage Plan

Although attenuation storage is not required to meet greenfield runoff rates in the case of a 1 in 100 year rainfall event with a 40% climate change allowance, it is proposed that incident rainfall on the mansard roof is directed to a green roof above the ground floor rear extension. Any excess drainage from the green roof will be collected and discharged to the combined sewer serving the property.

6. Risk Estimation

6.1 Probability of Site Flooding

The overall risk of flooding at this site is classed as ‘low’.

6.2 Climate Change

The predicted effects of climate change - more intense summer rainfall events and higher winter rainfall - could increase the risk of surface water flooding.

The Environment Agency Flood Map and Flood Zones do not currently take account of possible future climate change impacts. The potential extent of an extreme flood shown on the Flood Map might in future become more 'normal' as a result of climate change.

6.2.1 Adjustment for Potential Flooding from the Sea

The site is not considered to be at risk of flooding from tidal sources and no adjustment is required.

6.2.2 Adjustment for Potential Flooding from the Land and Rivers

The EA published revised guidance on climate change allowances for flood risk assessment in 2016, anticipating the total percentage change over the next 100 years. The range for peak rainfall intensity is estimated between 10% and 40% across England, with a range of 25% and 70% for peak river flows in the Thames (using 1961-1990 baseline).

6.3 Residual Risk

There is a residual risk of surface water flooding at this site.

6.3.1 Residual Risk Classification

Flood risk to people and property associated with new developments can be managed but it can never be completely removed; a residual risk will always remain after flood management or mitigation measures have been put in place.

7. Risk Evaluation

The risk of flooding from various sources has been assessed and the principal risk associated with the site is surface water flooding. At present day levels, there is an annual low risk of flooding from surface water of 0.1% to 3.3% within the vicinity of the site. The potential effects of this can be mitigated through protection of the property using an elevated sill to both the front and the rear basement areas.

There is negligible risk of tidal and fluvial flooding at the site.

Given the absence of a shallow groundwater and the presence of impermeable London Clay, the risk of groundwater flooding at the site is assessed as very low.

There will not be any increase in the impermeable area as a result of the development, and therefore an increase in surface water run-off is not anticipated.

8. Flood Risk Mitigation

Surface water flooding is the principal risk to the site, and the new development will need to provide sufficient disposal and drainage of the surface water to manage the surface water run-off. The use of Sustainable Drainage Systems (SuDS) is to be utilised to manage the storage and discharge of run-off.

To mitigate the existing and future risk of surface water flooding to the site and the surrounding area, the proposed green roof will provide an overall betterment of the existing surface water drainage regime for the site.

9. Conclusion

This assessment has shown that there is a potential risk of surface water flooding at the site but that the following steps will be taken to mitigate the risk.

- Reduce the surface water flood risk through the provision of elevated sills around the basement areas.
- Incorporate Sustainable Drainage Systems (SuDS) for the management of discharge.

By adopting the above measures, flood risk and its associated hazard to occupants and users of the proposed building can be reduced and mitigated.